ENGINEERING CONSTRUCTION WEEKLY

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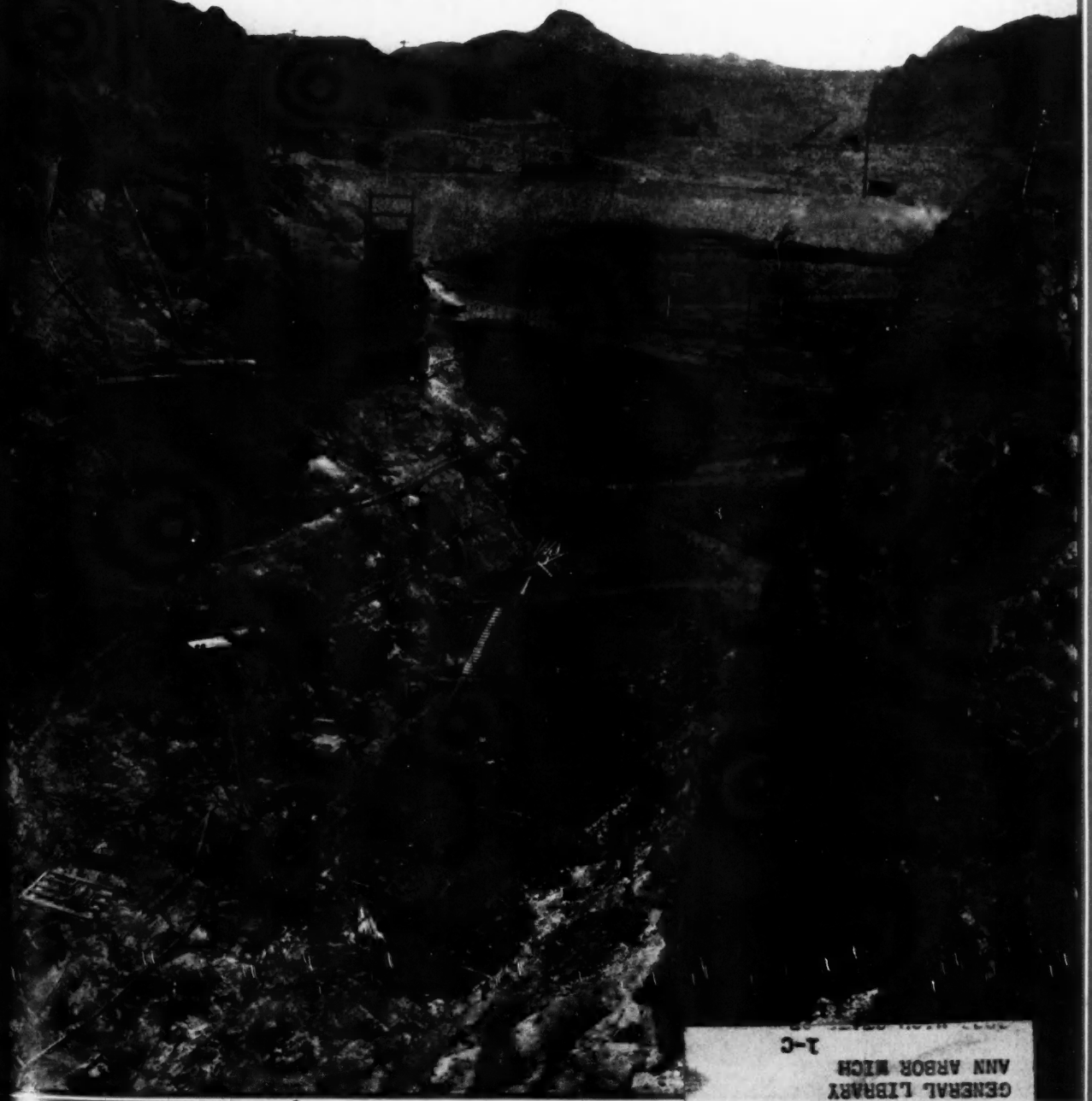
# Engineering NEWS-RECORD

November 25, 1937



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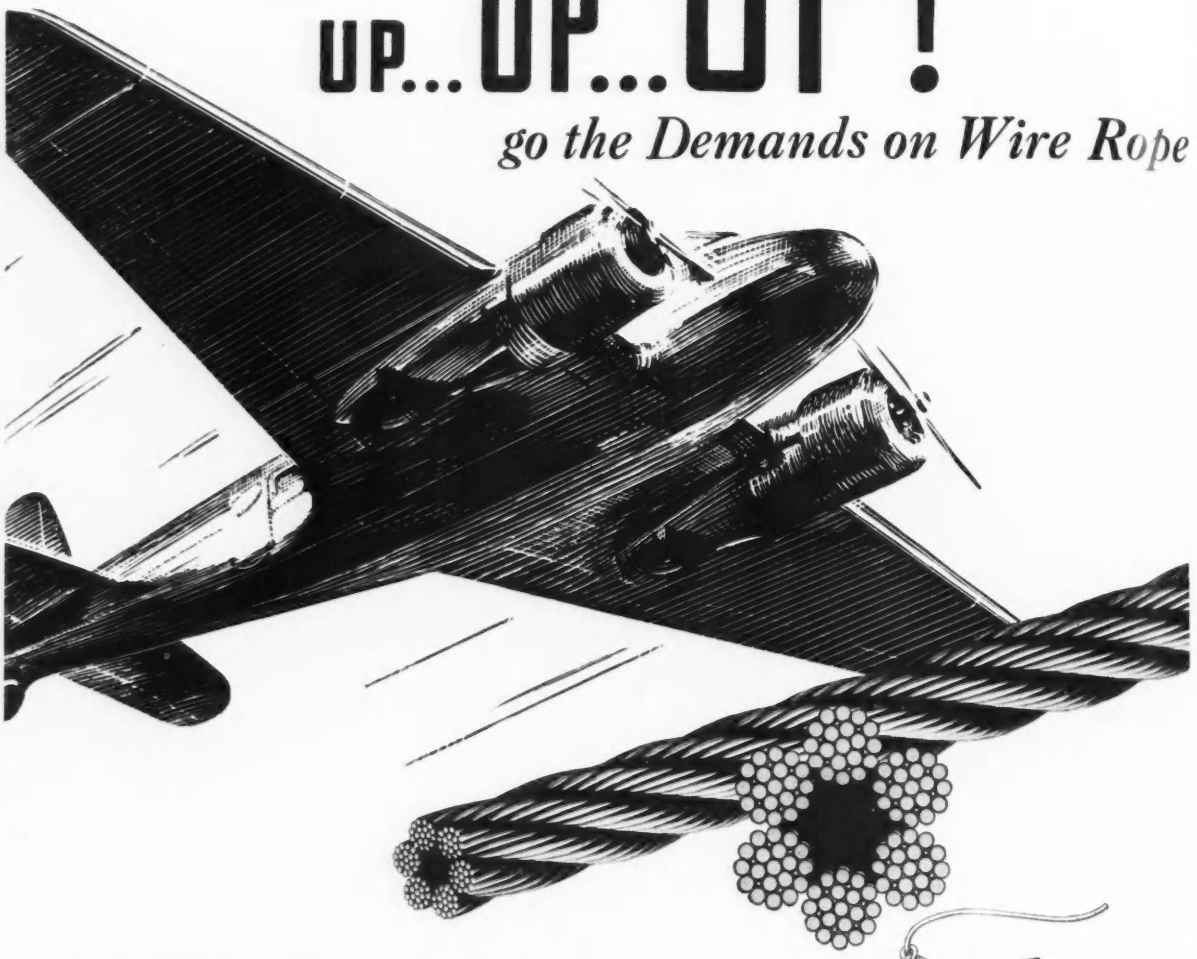
# UP... UP... UP!

## *go the Demands on Wire Rope*



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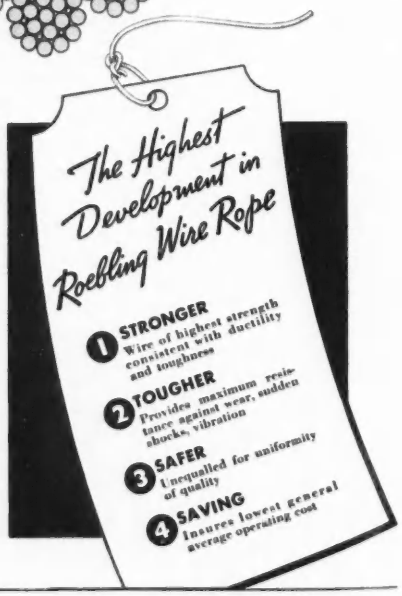
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1 STRONGER
Wire of highest strength consistent with ductility and toughness
2 TOUGHER
Provides maximum resistance against wear, sudden shocks, vibration
3 SAFER
Unequalled for uniformity of quality
4 SAVING
Insures lowest general average operating cost

**ROEBLING ★ BLUE CENTER**

# As Government Enters New Fields—II

*(Continued from last week's issue)*

LAST WEEK this page forecast an increasing participation by the federal government in the social and business life of the nation, and cited some unfortunate aspects of federal emergency activities.

If, then, we are to have a permanent extension of federal activity, we should leave behind us this psychology and technique of emergency. We should develop a new philosophy of federal administration and recruit a new corps of administrators. Of major importance is this matter of personnel and its mental attitude; and to that phase of the subject alone this piece is directed.

We must recognize, for example, that some of these new federal activities will involve fact-finding, others planning and still others administration. Some will be technical, some executive, some regulatory. And we must recognize also that each of these functions requires special talents. No man combines them all; few offer more than one of them. Because some statistician is a wizard at digging out the facts, it does not follow that he is competent to formulate a program based upon them. Because some professor can lay down a sound policy or plan, it does not follow that he is the man to administer it. In staffing the improvised agencies required to deal with an emergency, it may have been necessary to tolerate functional misfits; to project such snap judgments into a permanent plan would be pathetic.

BUT equally important with special aptitudes is the matter of administrative talent, especially in those who must deal with outside agencies. With few exceptions, all the federal agencies here under consideration will find it necessary to function through local offices and to deal with kindred local agencies or with industrial and business groups. Here will come the test as to whether federal intervention will justify the hopes of its advocates or the fears of its opponents.

It is said that the remarkable record of the British colonial administrator results from his ability to support an imperial policy and objective while, at the same time, he respects and tolerates to a maximum the local peculiarities of place and people. To extend the federal influence constructively over the empire that we call the United States calls for the same kind of talent.

Too often, our federal pro-consuls throughout the land lack the wit to discern local peculiarities, the tolerance to recognize them or the guts to seek from their bureau chiefs the special consideration that they deserve. Many of them tend to become "regulation-hounds." They play safe, stick to the letter of their books and let local needs go hang.

TO all this are many noteworthy exceptions; in fairness, it should be noted also that many bureau chiefs encourage in their field men the initiative that makes for constructive exercise of the federal authority. But too often it is lacking because the "federal man" fears that due respect for local conditions may imply a weakness he dares not reveal. These are the evils that beset all bureaucracy, whether in government or in corporate enterprise. Yet those who will administer the federal activities now foreshadowed by the march of events must aim to be bigger than that.

The paramount problem in any program of national development is to effect just this balance between local needs and national welfare. Both are vital to success. We cannot succeed by a narrow insistence on state or other local rights that prejudice the national welfare. Neither can we succeed by merely extending a federal bureaucracy through agents whose chief qualification is their authority.

If the federal government is to justify its growing influence in social and economic affairs it must solve this problem. Right now it should begin to train those who will wield its authority at points of local contact. Much of the futility and waste in its current activities arises from human failures. However excusable these may be in an emergency program, they should not be taken for granted in a long-term program such as now appears to be ahead of us.

Willard Chevalier

ENGINEERING NEWS-RECORD

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VOL. 119 *NOVEMBER 25, 1937* No. 22

## THIS WEEK AND NEXT

*EXCAVATING 235 ft. to bedrock for a dam that is to rise only 85 ft. above the stream bed was an unprecedented assignment for Bureau of Reclamation engineers. Add to this the job of protecting this excavation from flash floods of nearly 100,000 sec.ft. flow and you have a partial picture of the construction situation at Parker Dam.*

*In the second of his series on Wayne County, Mich., highways, Leroy C. Smith tells of 30 years' growth from 12-ft. roads to a county system in which nearly half of the mileage is at least 40 ft. wide.*

*Wm. Joshua Barney, New York building contractor and student of labor relations, presented a committee report before the recent A.G.C. board meeting that sounds a warning of dire consequences for construction unless labor and employer groups join in formulating a sound apprenticeship program.*

*Most flood formulas give inaccurate results for small watersheds. In this issue Victor H. Cochrane presents new formulas that are believed to eliminate such inaccuracies.*

*Rigid frames for viaduct bents are a new development in this country, although they are encountered in this service on some European structures. In Sacramento they have been used on a bridge approach over railroad yards, and on the new Blue Ridge Parkway two viaducts have been designed with rigid-frame rocker bents. The first of these is described in this issue.*

*HAND AND MACHINE PLACING of rock in rockfill dams is an interesting development in dam design that is recorded in a review of recent Algerian dam building to be published next week. Methods used in checking seepage through the dams also are noteworthy.*


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THE COVER PICTURE shows the uncovered bedrock and an earthfill cofferdam at Parker Dam on the Colorado River. Note the switchback road down the face of the excavation.

Number of copies of this issue printed: 30,531

# No More *Marker Maintenance* *Expense!*

*Atlas White pedestrian markers in Vermilion Street, Danville, Ill. City Engineer, L. H. Kirby; Contractor, R. McCalman, Inc., Danville.*

## *Atlas White traffic markers are permanent—require no upkeep—actually pay for themselves by saving maintenance expense*

Look *ahead* when you're planning marker jobs.

Consider the tremendous saving you'll accomplish by installing markers of Atlas White portland cement. These markers are *permanent*. This means that their first cost is the last cost. They'll never require maintenance. They actually pay for themselves over a period of years. And from then on they continue to save, each year, the maintenance expense which temporary markers require! Moreover, Atlas White markers are always white—always easy to see.

**Installed in coldest weather**

Even sub-zero spells don't hold up installation of Atlas White markers and curbs. Precast sections, made indoors, are simply moved to the job and set in place. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South La Salle Street, Chicago.

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ATLAS WHITE PORTLAND CEMENT
FOR TRAFFIC MARKERS

# THE WEEK'S EVENTS

STEEL MILL ON A HILL

STAGE of construction late last month of the new Irvin Works of the Carnegie-Illinois Steel Corp. is revealed in this aerial view. Set on a hill above the Monongahela River near Pittsburgh, the Irvin Works will be devoted to the rolling of hot strip, cold tin plate, sheets up to 72 in. wide and ¼ in. thick, and cold automobile stock. There will be no steel-making facilities at the new site.

An account of the unusual excavation problems being met in the construction here was published in the Nov. 11 issue, p. 781.

## *Flood Control Jobs Are Disapproved*

**Board of Engineers submits adverse reports to Congress on numerous flood control projects**

The Board of Engineers for Rivers and Harbors has submitted reports to the House flood control committee recommending against flood control projects on the Willamette, Deschutes, Sinslaw, Siletz, Mermentau, and Lewis rivers.

The board opposed any immediate congressional appropriation for the proposed $56,875,000 flood control project in the Willamette valley in Oregon (*ENR*, Aug. 12, 1937, p. 283).

No need was found for flood control construction on the Deschute River, an Oregon tributary of the Columbia, entering that river about 200 miles above its mouth. An exception is made in the case of Crooked River, a Deschute tributary, and a separate report will be filed on that stream later. There is no economic justification, the report said, for spending flood control funds on the Deschute River basin.

Flood control projects along the Sinslaw River, which flows into the Pacific 110 miles south of the Columbia, are "not warranted." The only practical method of control is raising existing dikes, closing sloughs, installing tidal boxes, and riprapping the banks at crucial points. The cost of these methods would be far greater than the total of the anticipated benefits.

Proposals for a survey of the Siletz River in Oregon as part of the flood control program in that state were disapproved by the board, which found that control of floods on that stream is impracticable. Control of the Siletz, which flows into Siletz Bay 92 miles south of the Columbia River, would require construction of storage reservoirs the cost of which "would greatly exceed the total estimated amount of damages which might be prevented."

Proposed improvements on the Mermentau River in Louisiana do not come under the provisions of the flood control laws, the board found, but are designed to establish sources of fresh water supplies for irrigation. The district, it was

*(Continued on page 847)*

## *FPC Assumes Jurisdiction Over Yadkin Project*

The Tuckertown hydro-electric project which the Carolina Aluminum Co. proposes to build on the Yadkin River in North Carolina will affect the navigability of the lower Peedee River and must therefore obtain a federal license before construction, the Federal Power Commission held in a ruling announced Nov. 17. (*ENR*, Sept. 16, 1937, p. 449).

FPC's decision was based on a finding that, although four unlicensed dams are operating between the project and the head of navigation, yet operation of the proposed dam might cause serious fluctuation in the flow of the river in its navigable section.

The proposed Tuckertown development consists of a gravity-type concrete dam and a 54,000-hp. power house to generate power for public service and for industrial use by the aluminum company. The dam, located immediately below the High Rock development of the same company, would be 1,320 ft. long and 93 ft. high and would provide 23,000 acre-ft. of usable storage. The power house would operate at a normal head of 65 ft.

## *MAJOR NEWS*


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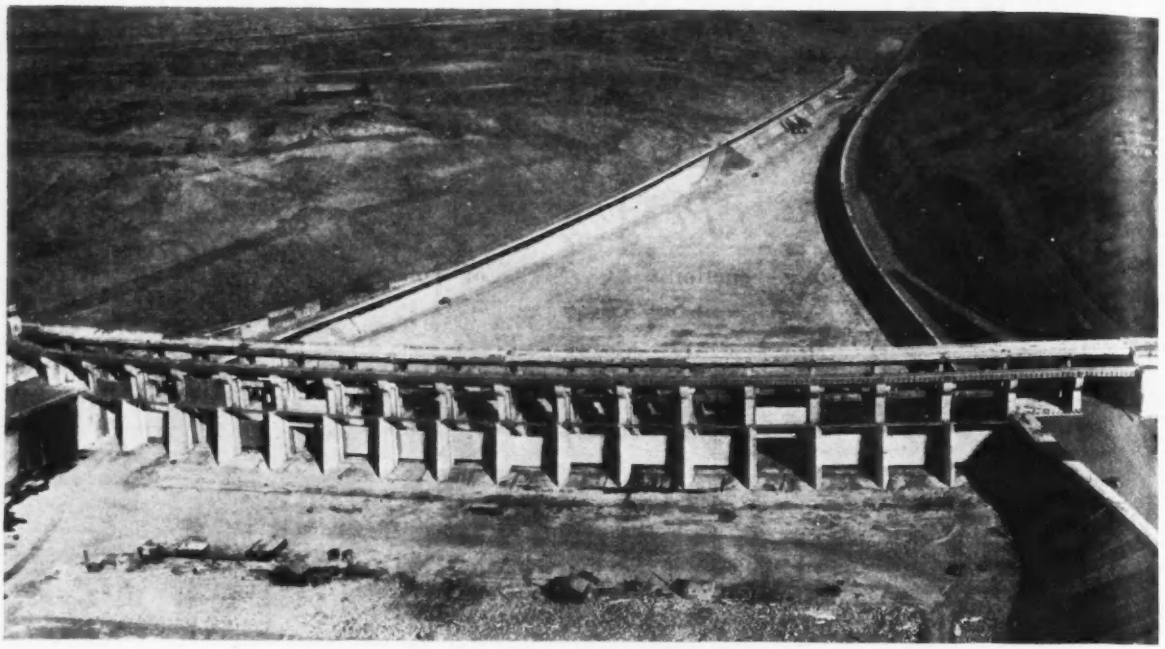


A ROUTE FOR MISSOURI FLOODS

THIS great spillway is intended to carry a possible super-flood in the Missouri River and prevent overtopping of the earthfill dam at Fort Peck, Mont.

The gate structure in the foreground, recently completed by the contracting firm of Addison Miller and Fielding & Shepley, consists of 16 vertical-lift gates, each 25 ft. high, and can pass 250,000 cu.ft. per sec.

Each gate is operated by an individual electric motor, and from the control tower at the left end of the highway bridge one man can raise any two gates or all together.

The concrete lined spillway extends for a mile below the gates, the sides converging as the slope increases.

## *Cast Iron Bid Is Low At Corpus Christi*

The lowest of the bids received Nov. 10 on 81,950 ft. of 30-in. water line for the water supply system of Corpus Christi, Texas, was made by Brown & Root, Inc., which offered to furnish tar-coated cast iron pipe with cement joints at a price of $7.62 per lin.ft. for Class I pipe and $7.18 for Class II pipe, totaling $620,000 for the job. The consulting engineers on the project, Myers, Noyes & Forrest, have recommended that this bid be accepted, but have recommended also that enough additional money be found to use cement-lined pipe instead of tar-coated. Brown & Root were low on this alternative, also, with unit bids of $7.97 and $7.52 for Class I and Class II, respectively, totaling $648,000.

Bids were asked on six types of pipe for this project. Two alternates for steel pipe covered pipe primed and enameled and pipe enameled and wrapped. Cast iron alternates were for tar-coated pipe with either lead or cement joints and cement-lined pipe with lead or cement joints. The low bid on a steel pipe line, offered by the Fredell Construction Co., was for $624,000, with the unit bid on the pipe $7.31 per ft. This was on enameled pipe. Low bid on enameled and wrapped steel pipe, at a unit price of $8.27 per ft., was offered by Christie, Hutchinson & Burton Co., Inc., with a total bid for this pipe.

Brown & Root was low in all the classifications of cast iron pipe. Their bids on lead jointed pipe were $649,000 for the tar-coated and $677,000 for the cement lined.

• • •

## *Landslide Breaks Main At Los Angeles*

A landslide in Elysian Park in Los Angeles, moving at the rate of about an inch a day, on Nov. 16 crushed 300 ft. of an important water main feeding three reservoirs for downtown water consumers.

A hillside above Riverside Drive in the park is sliding slowly downward. In addition to crushing the water main, the slip has already caused serious cracks in a park road on the hilltop and threatens to bury a section of Riverside Drive and the railroad tracks along the Los Angeles River. Traffic on the drive is still permitted, but the situation is being watched carefully and provision is made to stop traffic at any time danger appears.

## *Connecticut Building Work Goes to New Department*

Rendering an opinion in a second controversy as to the powers of Connecticut's new public works department, attorney-general McLaughlin of Connecticut has ruled that Public Works Commissioner Hurley, rather than the special institutional building commission, should have control of the $14,000,000 building program planned by the state. The question came up in connection with proposed construction of a home for the feeble minded at South Britain. The attorney-general held that the public works act passed at the last session of the Connecticut legislature supersedes an earlier act which delegated construction of this home to a special commission.

Commissioner Hurley has so far made no move to go ahead with the project because the special commission holds the tentative plans which have been drawn up.

A dispute as to whether the public works commission or the highway department has jurisdiction over highway construction in Connecticut is still in litigation in the courts. A lower court threw out the case on technical grounds but the matter is being carried to the higher court.

# THE CURRENT TREND

*This week's news of contract volume and construction cost factors*

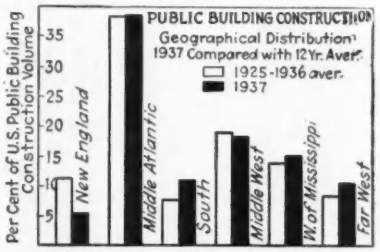
## Public Buildings 27 Per Cent Lower

### Public Buildings Construction 13 Per Cent of Total. Declines in New England, Increases in South.

Public building construction at its present rate should reach a $320,000,000 total for the year to take its place as the fifth highest on record. Last year established the all-time high public building total, $436,000,000, a reflection of building program financed both by PWA and regular federal funds. The depression low of $121,000,000 was in 1933. Prior to the 1936 high, 1931 with a dollar volume of $384,000,000 was the record year and it followed two $356,000,000 years. The average yearly total for the 12 years preceding 1937 is $281,000,000.

Public building awards for the 10 months of 1937 are 12.9 per cent of the total engineering awards reported by *ENR*. In the pre-depression years public building construction ranged from 7.8 per cent to 9.0 per cent of the total construction volume, while in the post-depression years it ranged from 11.2 per cent to 19.8 per cent of the total.

Public building construction activity is greatest in the Middle Atlantic states where 38.8 per cent of the volume is in 1937. This compares with a 12-year average of 38.6 per cent prior to this year. With Pennsylvania's $65,000,000 institutional building program in full swing it seems likely that these states will approximate the record of $138,600,000 they set last year. South's portion of the 1937 volume, 11.2 per cent, compares with the 12-year average of 8.0 per cent. West of Mississippi's portion for 1937, 15.2 per cent, increases over the average of 14.1 per cent; and Far West's 10.7 per cent for 1937 gains over the 12-year average of 8.6 per cent. New England's share of



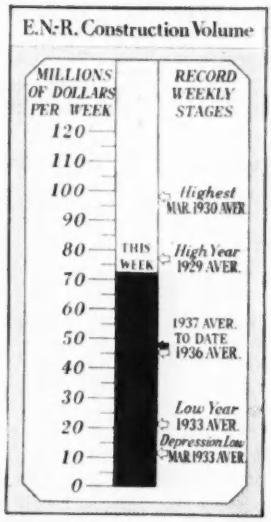

the 1937 total, 5.5 per cent drops from the average of 11.6 per cent; and Middle West's 18.6 per cent for this year decreases from the 19.1 per cent average.

### Business Briefs

CONCRETE PAVEMENT YARDAGE awarded during October for roads and streets dropped 46 per cent from October 1936, as reported by the Portland Cement Association. Alley yardage gained 16 per cent. Awards for the 10 months of 1937 are 1.7 per cent below the corresponding 1936 period. Reported totals are:

| | Square Yards Awarded | | |
|---|---|---|---|
| | October '37 | 10 mo. '37 | 10 mo. '36 |
| Roads | 2,403,377 | 35,047,113 | 34,057,156 |
| Streets | 852,438 | 11,469,815 | 13,377,636 |
| Alleys | 39,293 | 468,998 | 314,431 |
| Total | 3,295,108 | 46,985,926 | 47,749,223 |

SEPTEMBER EMPLOYMENT in the private construction industry decreased 0.8 per cent and payrolls 2.2 per cent from August, but gained 6.1 per cent and 23.2 per cent, respectively, over September 1936, according to the Bureau of Labor Statistics. Reports are from 10,652 contractors employing 144,260 workers engaged in erecting, altering and repairing private buildings.




## THIS WEEK'S FIGURES

(Thousands of Dollars)

### CONTRACTS

| | Week Ending Nov. 26 1936 | Nov. 18 1937 | Nov. 25 1937 |
|---|---|---|---|
| Federal | $7,517 | $2,655 | $ 977 |
| State & Municipal | 24,144 | 22,000 | 51,624 |
| Total public | $31,661 | $24,655 | $52,601 |
| Total private | 18,481 | 10,098 | 19,880 |
| TOTALS | $50,142 | $34,753 | $72,481 |

Cumulative
1937 (47 weeks) ..... $2,238,590
1936 (48 weeks) ..... $2,120,544

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

### NEW PRODUCTIVE CAPITAL

| | Cumulative. 1936 48 Wks. | 1937 47 Wks. |
|---|---|---|
| NON-FEDERAL | $892,638 | $1,364,139 |
| State & mun. bonds | 479,775 | 456,123 |
| Corporate securities | 233,992 | 499,951 |
| PWA loans, grants | 153,873 | 178,126 |
| RFC loans | 24,998 | 29,939 |
| Fed. aid for highways | ..... | 200,000 |
| FEDERAL | $691,237 | $746,223 |
| TOTAL CAPITAL | $1,583,875 | $2,110,362 |

### ENR INDEX VALUES

| Index Base | 1913 | 1926 |
|---|---|---|
| Construction Cost (Nov.) | 244.95 | 117.75 |
| Construction Volume (Oct.) | 167 | 73 |

## THIS WEEK'S LARGE CONTRACTS

| | |
|---|---|
| Shafts, Contracts 332 and 324; Delaware Aqueduct, New York, N. Y. | $33,944,000 |
| Dock and coal loader, Pennsylvania Railroad, Sandusky, O. | 4,000,000 |
| 200 residences, Wilson-Sullivan, Inc., Albany, N. Y. | 1,500,000 |
| Road and bridge improvements, Summit County, Akron, O. | 1,117,000 |
| Oil refinery, Texas Company, Port Neches, Tex. | 1,000,000 |
| Plant, Michigan Alkali Company, Wyandotte, Mich. | 1,000,000 |
| Highways, Alabama ..... $860,000 Highways, Texas | 678,000 |
| 20,000 tons steel rail, Southern Pacific Company, San Francisco, Calif., est. | 850,000 |
| Apartment, 955 Fifth Avenue, Inc., New York, N. Y. | 700,000 |
| Sixteen miles cast iron mains, Corpus Christie, Tex. | 620,000 |
| Coke ovens, American Rolling Mill Company, New Miami, O. | 500,000 |
| Housing development, Lyndhurst Estates, Inc., Cleveland, O. | 500,000 |

# Building Conference Turns To Rental Operations

**Chamber of Commerce conference studies ways to stimulate residential building with private funds**

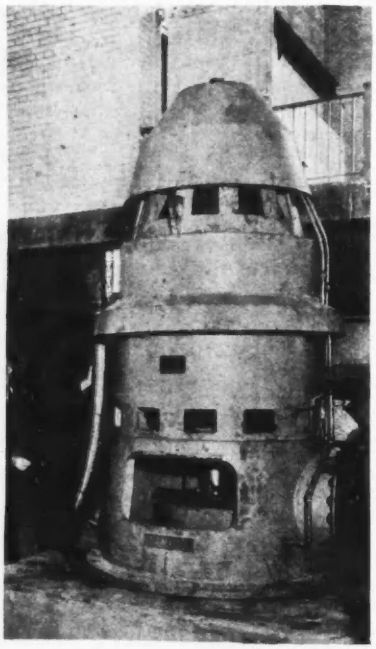
REALISTIC views of the housebuilding situation dominated the papers and discussions of the Conference on Local Residential Construction held at Washington last week under the auspices of the U. S. Chamber of Commerce. The conference, called by the Chamber some months ago when the rate of recovery in housebuilding was observed to have slowed badly, had as its theme the question of what is holding back housebuilding and how activity may be stimulated.

First consideration was given to construction figures and certain important influences controlling housebuilding, such as city-growth trends, effect of various restrictions, and the value of neighborhood protection, in papers by Lowell J. Chawner, of the Department of Commerce, Harold A. Merrill, of the National Resources Committee, Walter R. McCormack, Cleveland, and Harland Bartholomew, St. Louis. From this starting point the conference turned to householding finance and rental building. Strong emphasis was placed on the passing of home ownership as the basis of housebuilding and on the large market that may be found in building for rent. The principal discussions of this subject were by John H. Fahey, chairman of the Federal Home Loan Bank Board, on current problems of home financing, and by Charles F. Lewis, of the Buhl Foundation, Pittsburgh, and Stewart McDonald, Administrator of the Federal Housing Administration, on opportunities for building rental properties.

Other items of the program dealt with real estate taxation and methods of stimulating housebuilding. In addition Nathan Straus, the recently-appointed Administrator of the U. S. Housing Authority, outlined the principles that will govern the administration of the Housing Act.

### *Forecasting housebuilding*

Mr. Chawner charged that study of the factors which influence housebuilding has been greatly neglected until recent years. Vacancy surveys and real property inventories of the kind originated by H. W. Green in Cleveland in 1933 constitute almost the only efforts to analyze working factors. He cited four major influences that determine housebuilding: increase in number of families, increase in family income, change in family costs other than housing, and overall cost of building. His address was a strong plea for more thorough study of these factors.



*Westinghouse photo*

A LOT OF PUMP

ONE of two vertical 900-hp. pumps recently installed by the city of Spokane, Wash. These two pumps deliver 15,000 gal. per min. against a head of 420 ft. The pumps are automatically operated by remote control from a float switch in the reservoir.

With an overall plant efficiency of over 80 per cent, these pumps deliver water at a cost of less than one cent for each 1000 gallons.

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Mr. Merrill said that the national government has given much less attention to urban problems than to farm problems. The growing instability of cities arising from change in industrial and social conditions has a profound effect on housing habits, and today, with nearly 60 per cent of the nation's population concentrated in cities, urban housing is one of the nation's worst problems. Chronically depressed urban areas are a specially important problem. Mr. Merrill also emphasized that federal credit to local governments for public-works construction including housing should be provided for emergency use, and that a permanent federal public-works authority should be set up to formulate detailed, nationwide programs of public works.

Building-code obstacles to economical building were discussed in illuminating manner by Mr. McCormack. The practice of writing codes as detailed specifications is the cause for much of the trouble; a basic law and a board of review to prescribe details would improve the situation, in his opinion. Other obstacles are illustrated by the "Plumber's Yellow Book" in Ohio, a set of rules enforced by union restrictions, designed to increase the amount of labor and material required. It calls for 80 joints in a three-story stack, while 20 should be enough. A proposed electrical code would double the cost of wiring in small houses. The Ohio school code, he stated, increases costs fully 10 per cent because of excessive requirements for ventilation, double the number of plumbing fixtures required in other states, and the like. Labor restrictions also are claimed to be responsible for the fact that glazing steel windows in Cleveland costs twice as much as outside, because only two companies in the city are allowed to do such work.

Mr. Bartholomew spoke of the influence of effective zoning and the need for additional protection of residential investment, as by statutes permitting the organization of self-regulating neighborhoods within large cities. In his view the prospect for large increase in residential construction is doubtful unless the maintenance of high standards of environment can be better assured. "Housing today is a bad risk," said Mr. Bartholomew, "both for the owner-occupant and for the investor." He also remarked, "I have never seen a residential area that improved in value once it was built and few that maintained their value for any length of time." There is large opportunity, however, for rehabilitation work on an extensive scale, in his opinion.

Discussion of these papers turned largely on building costs, a number of speakers charging that cost-reduction is necessary to stimulate building while others asserted that building costs are lower than fifteen years ago, in comparison with agricultural prices. Further increase in costs was predicted, however, particularly as a result of the 40-hr. week. On the subject of building codes it was argued that obsolescence is due largely to inflexibility.

Chairman Fahey, after reviewing the large accomplishments of the Home Owners Loan Corp. in salvaging housing loans from foreclosure, said: "Unless the law of supply and demand has

been repealed nothing can prevent pressure of demand in this country for additional housing. There is no escape from the fact that we are actually short today at least 1,600,000 residential units in this country." He charged that business and finance in respect to the need for housing have "largely taken it out in talk," and said, "I think that it is time that the business of the country should get off of relief itself so far as the government is concerned."

### *Renting as a business*

Experience of the Buhl Foundation, developers of Chatham Village at Pittsburgh, and other commercial mass housing projects was cited by Mr. Lewis as demonstrating the opportunities for assured and profitable investment in rental housing. As a background he outlined the factors that have changed living habits and have overthrown the early or village doctrine that every man should own his own home: "It is time for all of us to recognize that changing conditions of life are making ever-increasing numbers of American families want to rent their homes rather than to buy them." Little effort has been made, he charged, to satisfy this potential market, and he closed with the statement: "The number of families who do not want to buy and who would flock to the kind of planned rental subdivisions of which I have been speaking is countless. Industry is idle; money is idle; the machinery for putting them to work is available. Let's get busy."

Definite effort is being made by the Federal Housing Administration to mobilize this rental demand, according to Mr. McDonald. Under Section 207 of the National Housing Act mortgages may be insured on large-scale projects up to ten million dollars each. By a recent change in regulations the FHA is also prepared to insure mortgages on large projects consisting of many single-family houses, and a projected further amendment will provide for any type of project either of row-house or apartment-house type, or in combination. So far 20 projects costing in all $18,000,000 have been insured under the FHA's large-scale rental housing program. This is regarded as only a start.

Countering the advocacy of rental construction, a number of speakers reaffirmed the principle of home ownership as the basis of residential building. J. M. Mowbray, Baltimore, in a paper proposing the abolition of real estate ad valorem taxes, suggested that opposition to home-buying is communistic and that buying a house supports the existing capitalistic system. He would increase the home-buying market by eliminating taxes except on income from real estate.

## *U. S. Nearly Half Mapped Ickes Reports*

Topographic maps now cover 47.4 per cent of the United States, the Geological Survey reported to Secretary of the Interior Ickes Nov. 16. The mapping agency's annual report, in which this statement was included, also revealed that new topographic surveys, re-surveys and revisions during the past year covered 14,502 sq.mi. in 36 states and in Puerto Rico. Topographic surveying of the United States has been in progress since about 1875, the extent depending on the annual appropriation. In the past few years extra funds have been provided by PWA.

Editing was completed during the year on 157 new topographic maps and on 753 miscellaneous maps, and on June 30 there were 322 new maps in preparation for reproduction and 239 in process of engraving and printing.

The geological map of Texas, prepared by the geologic branch of the Survey, in cooperation with state surveys and oil companies and private geologists, was completed and made available for distribution early in July, 1937. Fifty-nine parties in the field carried on work for the Geologic Branch during the year in 33 states.

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## *Detroit Settles Claim For Sewer Collapse*

The City Council of Detroit has accepted a $24,000 settlement of a $1,000,000 damage claim arising out of the collapse in 1930 of the Southfield sewer (*ENR*, July 3, 1930, p. 15; Aug. 7, 1930, p. 210). The contractor against whom the city held the claim is bankrupt, and the surety company is in receivership.

When several sections of the Southfield sewer collapsed and an investigating committee held that the failure was due to improper construction, the city entered suit against two contractors, Porath & Sons and Lennane & McIlvenna (*ENR*, Sept. 3, 1931, p. 383).

The city obtained a verdict of six cents against Porath Co., and the suit against Lennane & McIlvenna is still pending. Meanwhile, however, this contractor has become bankrupt and his surety company has gone into receivership.

The present settlement is the result of an agreement made with the trustee in bankruptcy for the contractor and the receiver of the surety company, who agreed to admit claims against them of $200,000 and $150,000, respectively. Since creditors of the contractor will receive about 1 per cent of their claims and creditors of the surety company about 15 per cent, the city's probable return will be about $24,000.

## *More Federal Aid Asked by Cities*

**Mayors discuss unemployment relief, housing, and airport construction at Washington**

A plea for continued federal aid to cities and for an increase in federal funds for certain purposes was the dominant theme of the United States Conference of Mayors at which more than 400 representatives of 150 cities met in Washington last week. Outstanding resolutions included a demand for continued federal relief of the unemployed, an endorsement of the Wagner housing act, and a request for federal aid in the construction of airports.

Although there was general agreement that relief for the unemployed is a burden still far too heavy to be turned back to local governments, resolutions on this subject were weaker than in preceding years. The mayors did not make a direct call on Congress for any specific sum but contented themselves with a hint that a deficiency appropriation would probably be necessary and a promise to submit definite figures in January. A further resolution called on the federal government to adopt some method of relieving the cities of the relief of transients.

### *Housing problems*

Nathan Straus, head of the new U. S. Housing Authority, explained that formulation of fundamental policy is now going on and that he hopes to be ready to receive project applications by Jan. 1. Meanwhile, he said, city officials should be considering their own obligations under the act—how to provide the 10 per cent of construction cost that must be furnished locally, and whether the cost limit laid down in the act can be met by the design to be submitted.

The Wagner act was criticized as being too rigid by Charles Abrams, of the American Federation of Housing Authorities. The cost limitation per room will work an injustice on many cities, he said, because the permissible limit is determined solely by the population of the city rather than by building costs there.

The conference adopted a resolution pledging full support to Mr. Straus and the USHA program and another calling on Congress to make provision for the rehabilitation of slum areas as well as for new construction.

The burden of providing terminal facilities for airliners of constantly increasing size is proving too much of a load to be carried by local taxpayers, city officials asserted. Federal aid to roads, waterways, and the early con-

(*Continued on page 846*)

# LABOR NOTES

MINIMUM wage scales for the new contract on the Grand Coulee Dam have been set by the Bureau of Reclamation after hearings. Minimum for unskilled labor is set at 60 cents an hour and for skilled labor, $1.20. Minimums for semi-skilled labor are not set, but will fall between the two. Divers, at $3.20 per hour, will be the highest paid workers. Operators of shovels and cranes will receive $1.50 per hour.

LOWER rates, apparently, prevail in Western Pennsylvania. There the U. S. Engineers have forwarded a schedule of rates to the War Department, with the request they be recommended to the Department of Labor as prevailing rates to be paid on construction at Crooked Creek Dam and Tionesta Dam, parts of the Pittsburgh flood control program, on which bids are to be taken soon. The schedule is based on an agreement recently entered into between the Constructors Association of Western Pennsylvania and the International Hod Carriers Building and Common Laborers Union of America, A.F.L. The section is divided into three zones, based on living costs. Common labor will receive 65, 57½, and 50 cents in the three zones. Rates for brick and block pavers are $1.625, $1.55 and $1.475; for machine operators, $1.30, $1.25, and $1.20. Cement finishers receive $1. $0.95 and $0.90, and caisson and tunnel men working under pressure receive a minimum of $1 in all zones. Operators of minor machinery—hoists, drills, compressors, big tractors, etc.—receive 90, 82½ and 75 cents, truck drivers and operators of small tractors, 75, 70 and 65 cents.

A THREE-DAY strike gained a 10 cents per hour raise for workers on twelve concrete structures in connection with the All-American Canal. An agreement made Nov. 14 between the Pacific Coast Co. the contractor, and a common laborers union raised wages of common labor from 45 to 55 cents per hour and provided that on future contracts of the Pacific Coast Co. 60 cents an hour will be paid. The strikers had sought a rate of 60 cents.

IN COLORADO too a strike gained its objective when the Colorado Builders Supply Co. established union conditions in its shop. A.F.L. steel workers on construction of the New Albany Hotel in Denver, refused to handle reinforcing steel furnished by the open shop Builders Supply Co. Negotiations between the company, the union and Mead & Mount Construction Co., contractors on the hotel, resulted in the building supply company notifying its employees they were free to join any union they desired. The men thereupon joined the union, and work resumed on construction Nov. 19.

IN WASHINGTON, work on an annex to the Library of Congress and on a new police court building was nearly shut down Nov. 18 by a walk-out of plasterers and marble setters arising, according to the contractor, the Consolidated Engineering Co. of Baltimore, from a jurisdictional dispute as to placing of the acoustical system in the Library of Congress annex. The stoppage at the police court building was understood to be a sympathetic strike.

THE DISPUTE about the use of local union men on reservoir clearing operations above Alton Dam on the Upper Mississippi River (*ENR* Nov. 4, 1937, p. 736) was settled Nov. 16 when James O'Brien, the contractor made an agreement with the St. Charles County, Mo. local of the Hod Carriers, Builders and Common Laborers Union to hire men from the local at 67½ cents an hour for tree fellers and draggers and 60 cents an hour for truck drivers.

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## *Federal Aid Asked*

(*Continued from page 845*)

struction of railroads was cited as precedent for demanding that the federal government assume at least part of the burden of providing facilities for air traffic, which, it was pointed out, is very largely in interstate commerce. The value of such facilities to the Post Office and the army air service was advanced as an added reason for federal aid. A resolution requested Congress to develop a permanent policy of federal cooperation in the "construction, improvement, development and expansion of municipal airports."

The conference recommended adoption by all cities of a schedule of qualifications for selecting public health officers. A medical degree and experience in public health administration are provided for in the schedule; the length of experience required varies with the size of the city.

Other resolutions included a request that Congress permit cities to purchase supplies on the same terms as does the federal government, through open contracts of the Procurement Division; an endorsement of the pending Lea bill for federal regulation of natural gas in interstate commerce; and a request for amendment of the banking laws to permit payment of interest on municipal deposits in banks.

## *Construction Figures Are Needed*

**Construction League meeting discusses need for better statistics from many viewpoints.**

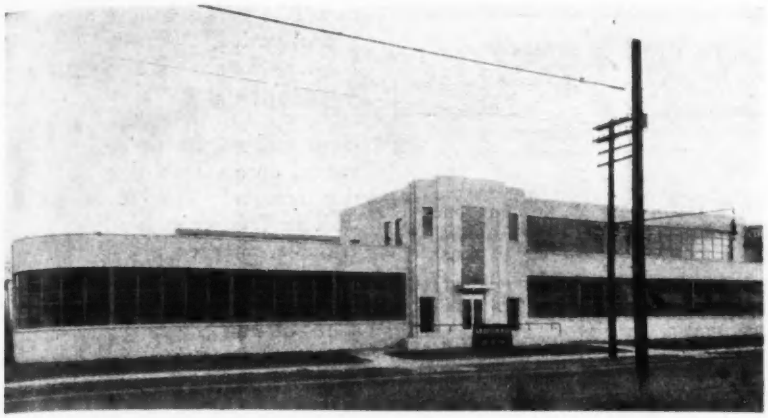
AT A MEETING of the Construction League held at Washington Nov. 18, the need for more extensive and accurate statistics from the construction industry was developed in a number of papers and discussions that brought out the practical value of improved statistics.

William Stanley Parker, Boston, chairman of the meeting, pointed out that the Department of Commerce spends $12,000 a year on the study of construction economics, while the Department of Agriculture spends more than five millions a year on agricultural economics. Lowell J. Chawner, chief of the Construction Economics Section of the Department of Commerce, outlined essential points of statistical study of construction. With an average annual volume during the '20s of $13 billions, and employing nearly 8,000,000 men in operations at the site and in production of materials, construction is a highly important agency in the release of funds to maintain purchasing power. To guide its activities properly there is necessary a study of market statistics to reveal the requirements for construction, a quantitative record of current operations, labor and wage data, statistics on construction financing, and analysis of the effects of construction on other activities.

Charles W. Eliot 2nd, executive officer of the National Resources Committee, spoke of the many problems that are involved in sound and systematic planning of federal public works. Many studies of the subject have been made by the National Resources Committee, but he conceded that the work has yet far to go.

Similar relationships of public work to factual knowledge were brought out by F. A. Pitkin, Director of the Pennsylvania State Planning Board. Budgets must be based on planning, and planning must be based on data. The work now being carried on in Pennsylvania to develop a comprehensive plan of state works, correlate local works plans and provide for the use of public works to stabilize employment in emergencies, show that the statistical approach to the problems involved is indispensable. The same is true of planning of city public works, as developed by Frederick H. Fay, chairman of the Boston Planning Board.

Statistical requirements in the fields of industrial and utility construction



CHOP SUEY IS BIG BUSINESS

THIS ATTRACTIVE building in Detroit, 228 ft. by 182 ft. in plan, is entirely devoted to the manufacture of chop suey for local and interstate distribution. The building is a beam-and-column frame structure with 20x30 ft. bays. It is faced with brick, incorporates large window areas, and uses glass brick.

The building was erected for the LoChoy Food Products Co. by A. W. Kutsche & Co., contractors. It was designed by Giffels & Vallet, Inc. and L. Russetti, associated engineers and architects, Detroit.

were discussed by Malcolm Pirnie, New York, those in the field of contracting by W. A. Klinger, president of the Associated General Contractors, and those of materials producers by R. G. Creviston, president of the Producers Council, who called for fuller detail in advance construction information as an aid to manufacturers in marketing. In conclusion statistical services were discussed by Thomas S. Holden, of the F. W. Dodge Corp., New York.

A. P. Greensfelder, St. Louis, in a luncheon address discussed construction solidarity. He traced the various attempts at organization within the previously disparate elements of the construction industry, beginning about 1905 and continuing through the post-war period (AGC) and the NRA code days to culminate in the formation of the Construction League. Projecting this movement into the future, he said that this correlation of the brains of various sections of the industry will be of great value in reaching the solution of a number of problems now pressing for solution, such as: a minimum guaranteed yearly wage; seasonal discounts on materials purchases to promote off-peak construction volume; "life insurance" for buildings; keeping construction codes up to date in all jurisdictions; apprentice training; decreased specialization in construction labor, resulting in more flexibility and fewer jurisdictional disputes; a continuous real property inventory in all cities; better control of hotel, office building and similar building volume to conform to requirements, possibly through some scheme similar to the certificate of convenience and necessity in the utilities field; banking reform; low-cost housing; etc. He also recommended the addition of a cabinet officer in the federal government to represent the construction industry.

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## *Golden Gate Bridge Faces Deficit*

Traffic over the Golden Gate Bridge has decreased to a point where press reports are referring to the likelihood of a levy on taxpayers of the district to make up operating deficits unless some means of increasing income can be found. Traffic revenues of the summer were good and continued so into August. Later they fell off sharply to half the summer high. Factors in the decrease were the lowering of fares on automobile ferries and the close of the vacation season.

At present a hearing is under way before the California Railroad Commission looking into the fares and the competitive operation of automobile ferries.

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## *Flood Control Disapproved*

(*Continued from page 841*)

stated, does not need flood control measures since it is not subject to overflows.

The entire project for flood control on the Lewis River, a glacial stream rising in the slopes of Mt. Adams, Wash., and flowing 93 miles to the Columbia River below Vancouver, was disapproved in a finding that it would not be warranted by the anticipated benefits, which are estimated at not more than $2,000 annually.

# WASHINGTON HIGHLIGHTS

*Special reports by Paul Wooton*

REPEAL of the capital gains tax as a necessary corollary of the President's plan for stimulating housing is seen as a distinct possibility. New enterprises to undertake large scale housing activities can be formed much more readily if this tax is made to apply only on gains on capital assets held less than one year. This would leave the purely speculative transactions still taxed.

Loss of revenue due to the removal of this tax from the sale will be offset in large part, it is believed, by the additional taxes that will come from increased transfers of stocks, bonds and real estate.

Repeal of the tax, it is estimated would release hundreds of millions of dollars of funds now frozen, much of which would flow naturally into the building and construction industry, it is claimed.

What might be interpreted as a promise that the death sentence clause of the Utility Holding Company Act, due to go into effect next January 1, will not be carried out precipitately appears in a recent opinion of the Securities and Exchange Commission approving a reorganization plan for the Peoples Light and Power Corp. Although the commission warns that it is fully conscious of the fact that the death sentence is still a part of the law, it qualifies this statement by adding that "it will often be necessary to accomplish the ultimate objectives of the act by a series of steps rather than by one direct and final step".

The Duke Power Company on Nov. 17 filed with the U. S. Supreme Court a brief detailing its charges against PWA, which, it argues, acted unconstitutionally in making a loan and grant to Greenwood County, S. C., for the construction of the Buzzards Roost hydro-electric power project. The brief attacked the entire power program of the Roosevelt administration, charging that the "yardstick" projects of the federal government and the local municipalities are intended "to short-cut and supplant the established lawful method of regulating rates" and are designed to force the electric power companies to make rate reductions "whether they are legally justified or not."

(*News continued on page 874*)

# COMMENT AND DISCUSSION

*Readers' opinions on matters that concern the engineer*

## Parker Dam Backwater?

Sir: May I call your attention to the enclosed picture from the San Francisco *Chronicle*.

"WOW!"

First the New Deal changed the name of the dam, and they then built it hind part before—a fact which you concealed (no doubt because of some type of rigid censorship) from the readers of your excellent magazine.

You may, or may not wish to publish this real news item in the *News-Record*. Such items often brighten up the dull days and tasks with which the engineer is beset.

DOZIER FINLEY
*Emeryville, Calif., Nov. 10, 1937*

## A Strong Union Needed

Sir: I have been reading with great interest the correspondence and articles on the unionization of engineers, published in *Engineering News-Record* during the past few months.

I am a mechanical engineer, a graduate of both Northeastern University and Massachusetts Institute of Technology. At the present time I am employed in the drafting room of a company having a plant in Hyde Park, Mass. After two years there, I am earning $16 per week. I am no longer considered a beginner since I execute minor designs and prepare complicated details with practically no supervision. My only hope of increasing my earnings appreciably lies in securing a "promotion" to a job as a laborer in the shop—a job which pays considerably more than I, or a number of draftsmen working with me, now receive.

You may be interested to know that this anomalous situation is typical of a number of plants, in the vicinity of Boston, where some of my friends are employed. Some of them are considering taking the same steps as I—that is, of transferring to the shop where they begin to earn enough to support a family.

To me, personally, this decision to transfer to the shop has been heartbreaking and has meant the shattering of many illusions garnered in college. I consider the technical training I have received a great social as well as a personal loss but I must earn a living.

I have become convinced that there is only one force that can change the unbearable situation I have outlined above. That force is a strong union of technical employees.

WILLIAM K. DEANE
*Dorchester, Mass., Nov. 8, 1937*

## Arch vs. Gravity Dams

Sir: Your editorial in the issue of Oct. 21 referring to gravity and arch dam designs, justly pointed out that the failure of 69 gravity dams but no arch dams did not necessarily give a "score" of 69 to 0 in favor of arch dams. A large number, possibly the majority, of the gravity dams that failed were built on sites which would not in any case have been suitable for arch dams.

It is true also that "the great majority of the gravity dams that failed were built long before dam building reached its present stage of development, and many of them in the days when the art was strictly empirical," but it is only fair to add that arch dams also passed through a long empirical period. One still in use was built as long ago as 1611, while Wade in the latter part of the last century built a number of bold arch dams in Australia with no more advanced design basis that the "cylinder formula." The old Bear Creek dam in California is a well known example of an empirically designed and, by modern standards, a poorly built arch dam which gave nearly 30 years of satisfactory service until it was flooded out by the construction of a higher dam immediately downstream.

Your editorial invites an examination of the records and I offer the following remarks. Although the design of both arch and gravity dams is still to some extent empirical, I believe it may fairly be stated that the modern period for gravity dams dawned about 1910, while that for arch dams came about 1920 with the publication of research by Noetzli, Cain, Howell and Jaquith, Guidi and some others. On this basis and taking only dams over 100 ft. in height, about one quarter of the dams of each type were built during the "empirical" period, so that in this respect gravity dams are under no disadvantage.

Any comparison of gravity and arch dams can be of value only in the limited range of cases where the site would be suitable for the construction of either type. Given such a site, there are to my mind certain definite and inherent advantages in the use of the arch principle in addition to its economy:

1. The stability of a gravity dam depends mainly on weight, and its effective weight can be seriously reduced by "uplift" and tailwater, neither of which has any serious effect on an arch dam.

2. As the water load increases, the factor of safety of the gravity dam decreases as the square of the depth of water, while that the arch dam decreases to a much less extent.

3. The arch dam acts as a whole and a minor weakness in one part of the foundation results in some part of the load being transferred to stronger parts, while each section of the length of a gravity dam must "stand on its own feet." In the failure of abutments of two arch dams described in *Engineering News* Oct. 14, 1926, p. 616, the upper part of

the abutments at one side of each was washed out, and one of the dams was subjected to overload. Yet the main structure of both dams remained unimpaired, and both were placed in service again by building up the washed out flanks. One gravity dam at least owes its continued existence to the fact that it is curved. This is the Avignonnet Dam on the Drac River in France. This dam is about 70 ft. high and is built on a gravel foundation. Its stability cannot be demonstrated by any of the rules of gravity dam design and can be explained only by the assumption that the load is transferred to the sides of the canyon by arch action.

If the comparison of the two types of dam be confined to sites suitable for either type, the records would seem to justify the "far-reaching conclusion" that "arch dams have inherently the greater reserve strength."

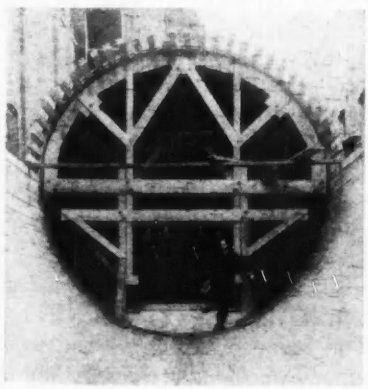
ROBERT A. SUTHERLAND
*Hastings, Neb., Nov. 3, 1937*

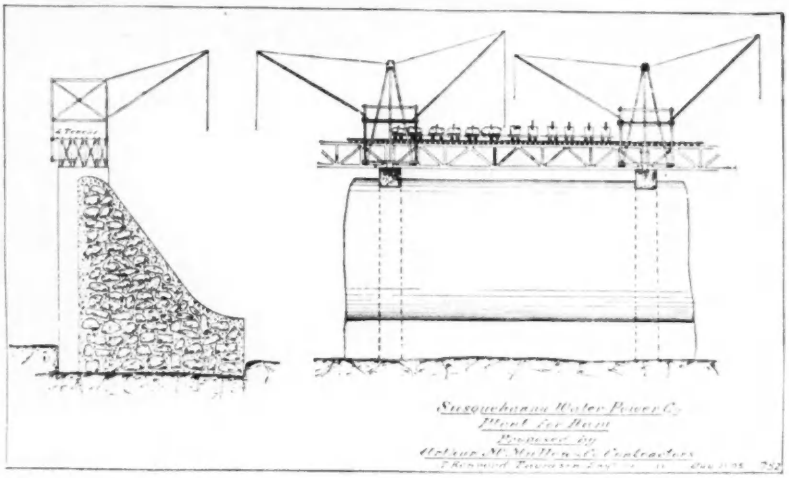
## Large Wood-Stave Pipe

Sir: In your issue of Oct. 21, on p. 686, it is stated that the 17½ ft. wood-stave pipe for the Ontario Paper Co. is said to be the largest in existence.

While we believe this true as regards a wood-stave pipeline in hydroelectric service, we would like to have you know that we have constructed for the International Paper Co., at Palmer, N. Y., a short section of wood-stave pipe, 19 ft. in diameter, and which the company at present is using for a blending tank. We believe this holds the record for being the largest diameter wood-stave pipe.

CURTIS D. KESEY
*Secretary & Treasurer, Continental Pipe Manufacturing Co., Inc., New York, Oct. 26, 1937.*





## Construction Bridges

Sir: A recent Sunday issue of the *New York Herald Tribune* carried a feature article concerning Grand Coulee Dam, which contained the following statement: Completion of a $500,000 steel bridge across the Columbia River at the site of Grand Coulee Dam, which will serve its purpose and disappear beneath tons of concrete within six months, was reported to Harold L. Ickes, Secretary of the Interior, today by John C. Page, Commissioner of Reclamation. This bridge is 3,000 ft. long and 175 ft. high and carries three standard-gage railroad tracks which extend from two great concrete mixing plants at the west and east abutments. Relays of cranes are moving back and forth across it continuously, hauling concrete in 4-cu.yd. buckets for placement in the dam. From the high bridge, cranes swing buckets to any point within a strip of 125 ft. wide."

Reading this, I am tempted to send you a plan of my own dated Aug. 31, 1905. That year, Arthur McMullen & Co. was asked to bid on construction of McCalls Ferry Dam in the Susquehanna River, on the basis of completing the work in two years. As chief engineer for Arthur McMullen & Co., I drew up the inclosed plan.

During the first summer we proposed to construct some eight piers, which would eventually form a part of the dam, and to carry these piers some 20 ft. above the top of the dam. As the next step—in the winter—we proposed to construct a permanent steel highway bridge, connecting the existing highways on each side of the river.

Before the following spring, we expected to have fixed, or travelling, derricks ready for use on this bridge and a concrete plant on the adjoining bank capable of turning out 4,000 cu. yd. of concrete, a day, without interference from the usual floods.

However, the McCalls Ferry Dam Co. decided not to accept McMullen's bid—and started work by day labor. Instead of building a high level bridge, which would be a part of the finished dam, they actually built a masonry arch low level bridge below the dam.

I was told that this low level bridge cost about $500,000 and took two years to build, with the result that the company had financial difficulties and the dam was not completed for some years later.

I was also told that the engineers who built the low level bridge used the high level type on their subsequent work, down South, but used steel, instead of masonry which would be a part of the dam.

T. KENNARD THOMSON
*New York, Nov. 3, 1937*

## Egg or Chicken?

Sir: The letter by Mr. Prentis in your issue of Oct. 28, 1937, brings up the old question of the chicken and the egg in a new form. He says WPA is causing unemployment. I think this problem should be dealt with seriously. Which did come first—WPA or unemployment?

G. R. KROTSER
*Mill Valley, Calif., Nov. 6, 1937*

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*NOVEMBER 25, 1937*


NEVER BEFORE have dam builders found it necessary to build the principal part of their structure below river level and even below river bottom, as is being done at Parker Dam on the Colorado. The foundation depth of more than two hundred feet below water sets up a record that will probably stand for a long time. The story of how this huge foundation pit was dug out and the river water controlled, as told on another page, sketches a typical picture of what the highly developed construction skill of today can accomplish under unusual foundation conditions. The story also brings into high relief the extent to which underground problems are taking a primary position in dam construction. A parallel instance is that of the Chickamauga Dam, whose unfavorable rock conditions were described some weeks ago. More and more it will be necessary to accept unfavorable dam sites, and therefore it will become increasingly important to find ways of building good dams on bad foundations.

## *The Housebuilding Slump*

WHY HOUSEBUILDING slumped and how it can be re-stimulated were the essential questions before last week's housing conference of the U. S. Chamber of Commerce. Neither question, it should be said at once, was answered in definite terms, but both are of quite obvious importance. As one speaker said, we ought to find out why a hundred thousand families who should have built houses this year decided that it was not a good time to invest in a house. Most of the discussion blamed general "uncertainty," evidently meaning uncertainty arising from government policies and actions. Regrettable as it may be to record it, this view reflects quite accurately the thinking of the man in the street. It is therefore not comforting to hear a government official say, as did a member of the Tariff Commission in addressing the Washington Society of Engineers, that business ought to consult a pathologist, If business feels uncertain, so do the common people: the housebuilding slump proves the feeling of uncertainty to be spread widely over the whole body of potential buyers and renters of better houses. In doing so it also shows that full recovery of construction depends not solely on demand and supply, or number of marriages and vacancies, but at least in part on what happens or does not happen in Washington.

## *Shortage and Boom*

DEMAND AND SUPPLY represent powerful elements in construction recovery under all conditions, and given reasonable confidence in the future they are certain to have their effect now. Therefore any forecast of future construction must keep in mind the volume of accumulated shortages. It is known that these are very large. In the single field of housing, Chairman John H. Fahey of the Home Loan Bank Board said to the conference on local residential construction that today we have a shortage of at least 1,600,000 units. His estimate is cautious, as much higher figures have been calculated by others. But even on the basis of his figure it would take the full production of three years to fill the gap; or, assuming that building meets all replacement needs and in addition produces a 50 per cent surplus, it would take six years to make up the shortage. The market for building is unmistakable; and any fears that the public housing program will affect it are unfounded, for the thirty or forty thousand units which Housing Administrator Straus hopes to provide will never even be noticed. Something should be done, however, to make sure that the boom is a sound one when it comes. Whatever can be done to protect the housebuilder's investment through subdivision control, good planning and zoning, safe and economical building codes, careful inspection, and adoption of conscientious methods in financing, ought to be done, and done promptly.

## *Looking at the Facts*

HOME OWNERSHIP was the magic word in connection with housebuilding activities for so many years that it became virtually an axiom. Meanwhile, however, the colonial and pioneer periods of our national life sank farther and farther below the horizon, and we arrived at the period of physical and economic mobility, or perhaps instability, in which we are today. Charles F. Lewis, Director of the Buhl Foundation, put the matter in expressive terms last week: "Ever-increasing numbers of American families want to rent their homes rather than buy them." This being so, it is plain that the construction industry will get nowhere in its thinking if it bases its housing calculations on home ownership. The day of the land developer who made city-lot profits

of farm land by building houses on it and ing them to the unsuspecting investor by the of "style" and gadgets is over. Instead, y's job is to build comfortable and substan- houses for rent, and this presents a new prob- in every aspect. It is encouraging to find this realistic view was shared by the leaders he housing discussion at Washington. It sug- s that we are headed toward the right goal, that in working toward it we will give fuller gnition to those essential factors—such as ilization of residential districts and proper ghborhood unit planning of new layouts—which make rental houses permanent investments.

# Seasonal Construction

CUSTOM, NOT CLIMATE, is mainly responsible for seasonal idleness in the struction industries." This statement opened the ort of the committee on seasonal employment ated as part of the conference on unemploy- nt called by President Harding in 1921. Within ew years thereafter, active study of winter con- ction established both the practicability and economy of cold-weather construction.

n a survey made ten years later by the Depart- nt of Labor it was stated: "Architects and con- tors no longer need to be educated as to the cticability of winter construction work. The ount of the winter construction activity how- r will be determined by the extent to which the eral public and particularly prospective builders educated to the safety, feasibility and desira- ty of building in the off-season."

o after ten years of intensive engineering im- vement in materials, equipment and processes winter construction, custom still dictated prac- . The old influences still prevailed: Inertia, the it of beginning building in spring; seasonal ting and repairs; reluctance of banks to finance ter work; overbalanced all the advances made naterials, equipment and processes.

After nearly another decade what is the situa- today? Is it improved? How much has the ual construction curve leveled out?

Five years of business depression and of extraor- ary emergency expenditures to stimulate con- ction have reshaped the construction chart. ere is some indication that the valley of winter eness is filling up. Engineering facilities for safe economical cold-weather operations are much re plentiful and certain. But what of construc- habit and custom?

There is no assured answer, and the construc- industry needs an answer. All the arguments spreading construction more evenly that pre- vailed in 1921 still prevail as construction enters 1938. One feels that old habits of closing down winter work and of not undertaking construction in winter are on the decline, but there are few actual figures to back up this impression. Another survey of seasonal employment in construction should be made. For today quite as much as in 1921, leveling the seasonal peaks and valleys in construction will be a powerful aid in stabilizing employment and production.

# Making a Precedent

BUT ONE CONCLUSION can be drawn from the Federal Power Commission's finding that the interests of interstate commerce will be affected by the construction of a power plant on the Yadkin River near Tuckertown, N. C.: the commission is seeking indirectly to extend its control far beyond any point to which it could be extended directly by act of Congress. Congress gave it control over power plants on those streams over which Congress has jurisdiction under the commerce clause.

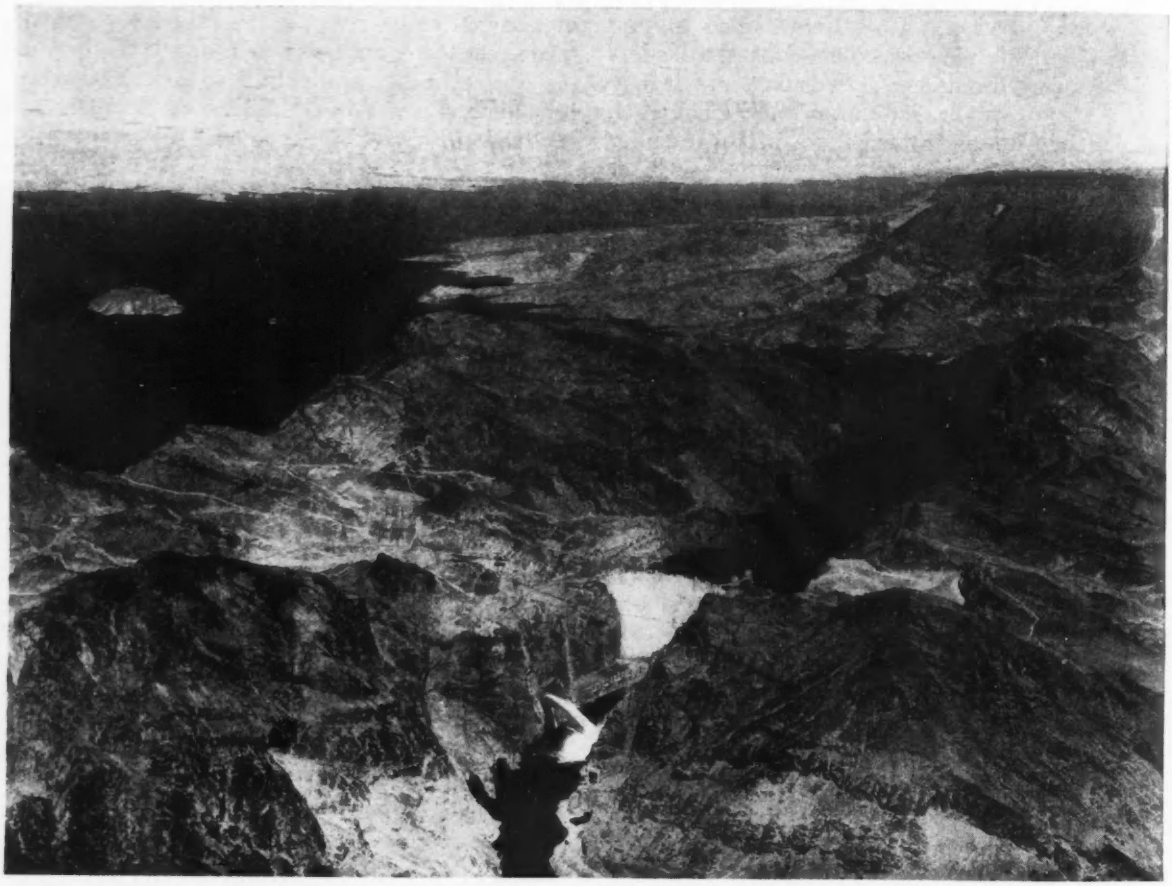
But the commission claims jurisdiction over plants on streams flowing into navigable rivers, on the ground that fluctuations in the flow of those streams caused by the power companies could adversely affect navigation. The Yadkin River case marks the ultimate extension of that theory. The Yadkin flows into the Peedee, nominally a navigable stream, but the channel in the upper reaches is only 3½ ft. deep and its use is so negligible that the Chief of Engineers has recommended its abandonment.

Efforts to get a Supreme Court ruling on such extension of the commission's authority have been unsuccessful. If the commission can get enough of its findings made effective for a long enough time it will have established a precedent that no court will overthrow. The outcome is obvious; by degrees, federal control over all streams will be made complete because they all reach navigable waters ultimately.

In support of this conclusion witness also the way in which the Federal Power Commission blocked approval of the New England states flood compacts. The price it has set on its approval is recognition of federal authority over potential power sites that are now beyond its control.

Under the act setting up the commission all plants that are licensed by the commission can be recaptured by the government at the end of 50 years. Thus the question of ultimate federal ownership of most large new hydro-electric plants depends on how successful the power commission is in what it has undertaken. Possibly such ownership is desirable, but that is a question for the nation, not the Federal Power Commission, to decide.

# PICTURES IN THE NEWS



**BOULDER DAM'S MIGHTY MASS OF CONCRETE.** *wedged between the walls of Black Canyon is dwarfed here by part of Lake Mead, which is 115 miles long. The reservoir is now half full.*

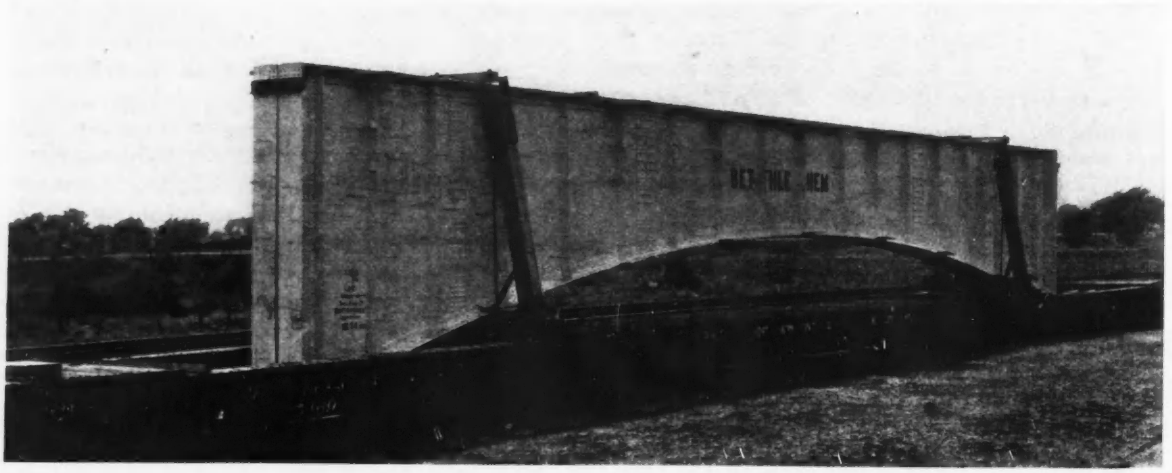


**PLATE GIRDERS** *of special shape being shipped on three flat cars from Chicago to LeClaire, Iowa, where they will be used with six similar girders in a service bridge for the new Mississippi dam there. They are 105 ft. long and weigh 38 tons apiece.*

# Deep Excavation for Parker Dam

***While trucks and skips were uncovering the Colorado River bed, earth cofferdams protected the pit exceeding the capacity of the diversion tunnels***

UNCOVERING the bedrock for the foundation of Parker Dam, impounding dam for the great Colorado River Aqueduct, was a unique job because of the unprecedented depth of excavation as compared to the moderate height of the dam above streambed. Of the 320 ft. height of the concrete dam only 85 ft. is to rise above streambed; the remaining 235 ft. is to be forever buried in the river bottom.

The first work on the project was driving two 29-ft. diversion tunnels about 1,730 ft. long, which were put through the Arizona abutment and lined with concrete. They have a horseshoe section, were built solely for bypassing stream flow during construction, and will be sealed with concrete plugs after the dam has been completed. While the dam foundation was being excavated, they had to carry 4,000 to 11,000 sec.-ft. from the Colorado River, which is regulated at Boulder Dam, but in addition had to cope with the unregulated flow of Bill Williams River, tributary just above Parker Dam, which may change from a normally insignificant flow to a peak of 100,000 sec-ft. overnight. Because of the large flood hazard thus created the Bureau of Reclamation which is building the dam for the Metropolitan Water District of Southern California, designed the diversion system with a capacity of 60,000 sec.-ft. and also provided for flood storage about the tunnels. Upstream and downstream cofferdams were designed for flood conditions, and contract specified that the cofferdams when once built would be at the risk of the bureau.

The cofferdams, constructed with material excavated from the dam site, are rolled fills placed on a foundation excavated about 15 ft. below the river bed. The fill material was graded in order to place the fines near the water face and coarse material in

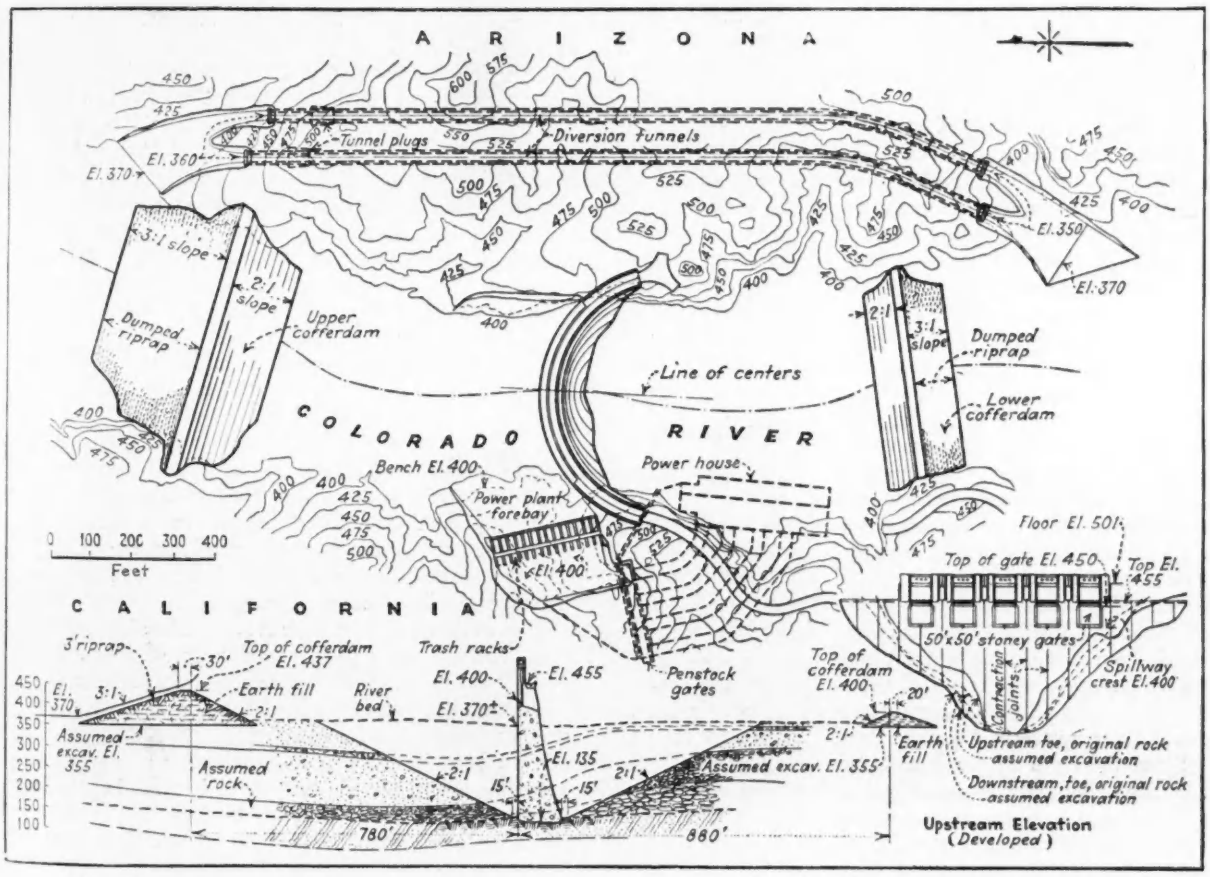



**Fig. 1.** Parker Dam is being built in a deep excavation to rock, 235 ft. below the bed of the Colorado River.

Fig. 2. Excavation for Parker Dam when the work was about half completed showing the truck roads and the cableway.

the back. A blanket of selected fine material, stripped from the site and placed on the water faces of the cofferdams, varies from 4 to 6 ft. in thickness, protected by 3 ft. of riprap.

When the diversion tunnels were ready the river was turned through them and the foundation area, enclosed by temporary dikes, 1,500 ft. apart, was unwatered. Excavation was started by draglines loading to dump trucks; later much of the material was handled by 5-yd. skips on a cableway, which loaded 30-yd. dump cars running on standard-gage tracks. Part of the material excavated went into the upstream and downstream cofferdams, and during the early part of this work excavating procedure was somewhat complicated by the necessity for taking the material from selected areas in order to grade the fill in the cofferdams. About one-fourth of the total 1,400,000 cu.yd. excavated from the dam site went into the cofferdams; the remainder was wasted, mainly on the California side of the river upstream from the dam.

Since the sides of the foundation area are sheer cliffs, trucking had to be done on the upstream and downstream slopes of the excavation. Truck roads with hairpin turns were built down these slopes and into the excavated area on 10 per cent grade. At El. 175, which was about 195 ft. below river bed, this method of excavation became generally impracticable, although some material from sides of the pit was removed by trucks from levels as low as El 165. At lower levels cableway skips hauled spoil.

The two cableways used in this operation were brought from Boulder Dam; they are of 25-ton capacity and have 1,500-ft. span, a common tail tower on the California side of the gorge and independent traveling head towers on the Arizona side moving on radial track 500 ft. long.

### Troublesome seepage

From the very beginning of the excavation inflow into the pit exceeded expectations. Water that seeped in through porous material of the river bed was pumped out from a central sump by a battery of motor-driven centrifugal pumps, which, in the early stages, were mounted on barges so they could stay at water level as this level went down. These pumps were handling a steady flow of 27 sec.-ft. by the time well pumps were installed, which reduced the load on the barge pumps to less than half their maximum.

As the excavation went deeper inflowing water affected the stability of the material and made it impossible to maintain the 2:1 excavated slope, as had been planned, without some aid. This aid was provided and the ground was stabilized by four 26-in. wells which were sunk almost to the bedrock, two in the upstream and two in the downstream slopes of the excavation. These wells, each equipped with a 10-sec.-ft. centrifugal pump, effectively lowered the level of the seepage flow and kept much of the water out of the central part of the excavation. The maximum flow handled by well pumps was 25 sec.-ft.

Two rows of steel sheetpiling in the downstream slope of the excavation helped in holding the ground and controlling the inflow. Each row of sheetpiling was held in place by a concrete arch, 4 x 4 ft. in cross-section, which also guided the piles as they were driven. The upstream face gave less trouble and stood without the aid of arches and steel sheetpiling.

When the excavation was completed two arched retaining walls were built at the toes of the excavated slopes, i.e. at the foot of the future dam. These walls created two sumps which caught all inflowing

water that escaped the sumps and wells above. The retaining walls greatly facilitated the final cleanup and preparation of the foundation for concreting; they also served as forms for the first pour of dam concrete, which came to their tops.

All pumps discharged into three 22-in. steel pipe lines delivering into the river channel beyond the temporary downstream dike. Where the steel pipes went through the rolled fill of the cofferdam they were embedded in concrete to prevent seepage dangerous to the fill.

The quantity of water pumped, starting with about 14 sec.-ft. when excavation began, increased steadily, and reached 37 sec.-ft. by the time the bottom was reached. Although the original power supply was sufficient in quantity, it was subject to a possible outage, and to insure uninterrupted service a second source was provided by connecting with the Metropolitan Water District's power line at Gene pumping plant. The importance of the uninterrupted supply was well demonstrated last June when the power was shut off for 35 minutes to permit making connection to the new source; during this outage, the pumps being stopped, 1,500 cu.yd. of river bed material sloughed into the pit from the back slopes.

Fig. 4. Parker Dam diversion works consisted of an earth dike and tunnels that carry the flow moving to the right. The Bill Williams River comes in from the right to join here with the Colorado River which comes in from the left.

Fig. 3. Completed excavation for Parker Dam, looking downstream. Bedrock on the bottom is bounded by the two concrete retaining walls. Grout pipes appear close to the upstream wall. Note two concrete arches and steel sheetpiling in downstream slope; higher up are two pumping wells.

Last February, without warning, the Bill Williams River had one of its typical flash floods. Warm rain falling on its snow-covered drainage area caused a very large and quick runoff. In a short period the flow increased from a few second-feet to a peak of 93,000 sec.-ft. Flood storage back of the upper cofferdam took the peak off the flood and brought the maximum discharge through the diversion tunnels down to 42,000 sec.-ft., less than half the actual stream flow. Fortunately the extreme flow continued for only a few hours, as is usual with the Bill Williams' floods; nevertheless the upper temporary dike was overtopped and washed out. Fortunately this caused no serious damage, as the upper cof-

TABLE I.—STATUS OF PARKER DAM WORK AS OF OCTOBER 22, 1937.

| Item | Unit | Estimated total | Current week | Total to date | Per cent complete |
|---|---|---|---|---|---|
| **Outlet Works:** | | | | | |
| FOREBAY | | | | | |
| Excavation | cu. yd. | 220,000 | 0 | 207,176 | 94 |
| TRASHRACK | | | | | |
| Concrete | cu. yd. | 5,000 | 100 | 3,522 | 70 |
| Metal work | lb. | 948,000 | 0 | 118,154 | 13 |
| Reinforcing steel | lb. | 350,000 | 0 | 207,613 | 59 |
| **Dam:** | | | | | |
| EXCAVATION | | | | | |
| Common | cu. yd. | 1,400,000 | 0 | 1,375,209 | 98 |
| Rock | cu. yd. | 83,000 | 0 | 82,170 | 99 |
| Spillway approach and road wye | cu. yd. | 19,200 | 0 | 17,000 | 87 |
| Average El. of excavation | | 140 ft. | | | |
| CONCRETE | | | | | |
| Mass | cu. yd. | 270,000 | 15,131 | 141,934 | 51 |
| Piers, bridges, operating house, etc. | cu. yd. | 17,900 | 0 | 0 | 0 |
| Average El. of concrete | | 315 ft | | | |
| METAL WORK | lb. | 3,125,000 | 0 | 0 | 0 |
| **Power house substructure:** | | | | | |
| Excavation, rock | cu. yd. | 25,000 | 1,000 | 24,700 | 99 |
| Excavation, common | cu. yd. | 33,000 | 0 | 31,700 | 96 |
| Concrete | cu. yd. | 14,000 | 0 | 0 | 0 |
| Average El. of excavation | | 308 ft. | | | |

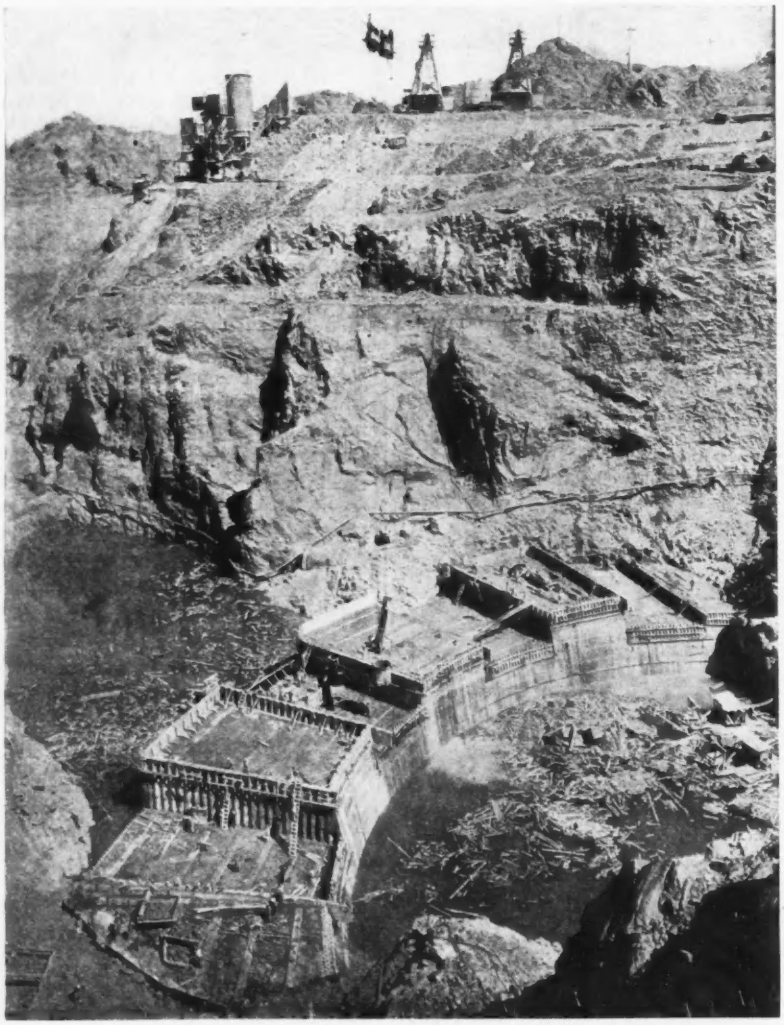


Fig. 5. Progress in concreting late in September. The concrete mixing and batching plant is in the upper left.

ferdam had reached El. 413, or 8 ft. above the flood high-water surface.

The downstream dike, at the same time, was menaced by the turbulent outflow from the diversion tunnels, which threatened to scour and undermine it. Failure of this dike might have been disastrous, as the downstream cofferdam had not yet been brought up high enough to protect the excavation. The dike was saved by continuous energetic efforts of the contractor, who mobilized his forces and kept dumping rock on the downstream face as swirling water from the tunnel kept washing it away. In the meantime, as a secondary defense the top of the downstream cofferdam was quickly raised 10 ft., the height needed to protect the pit should the dike fail. This was accomplished by scraping the material already in the cofferdam up to the water side, thus forming a thinner but a higher dam.

### Present status of construction

The concreting plant on the Arizona side of the river, upstream from the abutment, contains two 4-cu.yd. mixers fed by weighing batchers which receive cement and aggregate by gravity from silo and bins above. Concrete from the mixers is discharged directly into 8-cu.yd. buckets standing on a standard-gage railroad track that extends under the cableways already mentioned. The cableways deliver the buckets wherever required in the dam. The mixer plant was brought from Boulder Dam and employs the same automatic control previously used. Since the first concrete was placed on July 31, 1937, the average rate of placement has been 1,700 cu.yd. per day. By Oct. 22 more than half of the total 280,000 cu.yd. had been placed in the dam. In Table I are listed various quantities involved in this job as well as the progress to Oct. 22, 1937.

R. F. Walter is chief engineer of the U. S. Bureau of Reclamation and E. A. Moritz is construction engineer at Parker Dam. The contract for the construction of Parker Dam was awarded in August 1934 (*ENR* Aug. 30, 1934, p. 286) to Six Companies, Inc., by whom a subcontract for the diversion tunnels was let to J. F. Shea Co., Inc. This latter firm later assumed direction of the contract, with Frank Crowe, general superintendent and E. P. Sowles, engineer.

FIG. 1. GRADE SEPARATIONS AT BOTH RAILWAY AND HIGHWAY CROSSINGS ARE CURRENT OBJECTIVES

# Roads Grow to Superhighways

by LEROY C. SMITH
Engineer-Manager, Wayne County Road Commission, Detroit, Mich.

***From two 6-ft. travel lanes 30 years ago the roads of Wayne County, Michigan, have grown to paved widths up to 90 ft. and dual roads 204 ft. wide.***

IMPROVEMENT in organization and technical practices over a period of thirty years of road system development in Wayne County, Michigan, (*ENR* Nov. 11, 1937) found an outstanding task in widening existing roads and perfecting their geometrical form. Of course this change has been common in all roadbuilding and particularly in metropolitan county road-building but in Wayne County, with its population of nearly two millions including the city of Detroit, it has been more nearly a gradual evolution. Country roads have grown to superhighways, which is quite different than the more common practice of laying down fully grown a new superhighway on an old road.

As the result of this growth, of the 685 mi. of paved county roads and state trunk-line highways in Wayne County, nearly one-half (332½ mi.) has pavements at least 40 ft. wide. This mileage does not include streets in Detroit or other cities in the county that are not also state or county roads. Later in this article, the mileages of wide road are given in more detail but here it is sufficient to state that no other county system has such a proportion of extra-width pavements. As a measure there are in the United States, according to figures published by the Association of State Highway Officials, only about 3300 mi. of road paved four lanes wide or wider. But enough of comparisons, the important fact is that Wayne County has worked out its wide-road system on a definite plan.

Widening has been a continuous policy since modern improvement began 30 years ago. First it was enlargement to provide for growth in traffic-lane width and after this had reached modern standards it was enlargement to provide more traffic lanes. This first phase of wide-road development after about 20 years grew into a second phase of superhighway planning and a notable master plan for superhighways. Naturally there were many ramifications to this development and to enlarge on all of them will go beyond reasonable interest. But the general growth from primitive dirt roads to surfaced roads, to wider and wider traffic lanes, to more and more of them and finally to a master plan of superhighways is of particular significance now when transport is pressing for safer roads of greater capacity and it is a growth that is worth reviewing.

### Lane width grew first

As had been the fact generally, there was no real development of highway construction in Wayne County until the people voted to adopt a commission-managed county-road system. This was in 1906. At that time the roads were in the most part clay, sand and swamp roads, although there were a few miles of gravel and stone travel sur-

**Fig. 2.** One of the widened concrete pavements with a white cement insert center-line marking the opposing lanes.

faces. Interestingly enough, among these roads were a 66-ft. wide military road constructed by the United States Army in 1812 and five great military roads radiating from Detroit and laid out about 1825 that were 100 ft. wide, but encroachments had reduced these widths until the roads were but wagon trails.

When the county road commission began its operations, a definite width of highway had to be established. In determining this width, consideration was given to all of the then existing conditions involving highway traffic. The first problem was width of road metal. The roads built in the county during the first two years consisted of about 12 ft. of road metal with shoulders about 4 ft. wide. These dimensions were soon changed when it was obvious that a 6-ft. traffic lane was too narrow to permit ease in passing other traffic. In 1908, the commissioners decided on and adopted a road 24 ft. wide consisting of 16 ft. of road metal and 4-ft. shoulder on each side. The road metal at this time was either waterbound gravel or macadam or tarbound macadam.

This new width of road metal established an 8-ft. traffic lane which then was standard in all parts of the country, and even with the increasing automobile traffic still exists in parts of the country. In Wayne County the plan lasted only one year. In 1909, when the first mile of concrete road was built on Woodward Avenue, the width of road metal was increased to 18 ft., thereby establishing 9-ft. lanes. It was not long before another foot of lane width was added and today, the traffic lanes on all highways, except certain drives, are 10 ft. wide, and the minimum width of any pavement constructed is 20 ft. whether it be single highway or a strip of a divided highway. On drives, such as Outer Drive and Lake Shore Drive, the traffic lanes are 9 ft. wide, but the pavements have a minimum width of 27 ft.

### More lanes called for

As the volume of traffic has increased it has been served by adding traffic lanes to provide for the increase and now some of the roads in the country that were originally 18 and 20 ft. wide are 30, 40, and even 60 ft. wide. The sections in business centers were the first to be widened; later as reconstruction was necessitated, some of them were constructed 80 and 90 ft. wide. This is especially true on such important thoroughfares as West Jefferson Avenue through the important industrial communities of River Rouge, Ecorse, and Wyandotte; as Woodward, Gratiot and Grand River avenues in the city of Detroit, and as East Jefferson Avenue in the village of Grosse Pointe Park.

Many of the early roads constructed were designed with a central reservation for street car tracks. This is not to be confused with the superhighways and divided highways which have been built since 1924 and which are a vital part of the modern master plan of highways and superhighways which will be discussed hereafter.

As Wayne County was growing and new centers were being developed, the highways were extended to these growing communities. In most cases highway construction preceded street railway construction, and on roads where such street railway construction was contemplated the pavement was laid in two strips. The railway construction has since become a reality on most of these roads, but has never been effected on some of them, and where traffic conditions demand and no future railways construction is contemplated, these central reservations have been paved.

A recent operation completed in 1936 is Wyoming Avenue in the cities of Dearborn and Detroit, a direct north and south road beginning at the north limits of the county, and the section improved was 1.64 mi. long; the methods followed exemplify procedure.

On one section, the existing 40-ft. concrete pavement, was widened to 60 ft. An 8-in. concrete base course 20 ft. wide was constructed adjacent to the east edge and to the grade of the former pavement. The overall width was then resurfaced with a 3-in. sheet-asphalt surface consisting of $1\frac{1}{2}$ in. top and $1\frac{1}{2}$ in. binder. A second section consisted of two strips of pavement each 21 ft. wide with a central reservation of 18 ft. between the two. In this section a 10-in. concrete pavement was constructed in the

unpaved section making the overall width 60 ft. In a third section, also consisting of two 21-ft. strips with an 18-ft. central reservation, an 8-in. base course was constructed in the center space to the grade of the existing strips. The overall width was then resurfaced with a 3-in. sheet asphalt surface consisting of 1½ in. top and 1½ in. binder.

To show the accomplishment in the county in building wide pavements, the mileages of these roads are summarized as follows:

| | |
|---|---|
| Mileage of pavements 40 ft. wide | 147.45 |
| Mileage of pavements 40 to 60 ft. wide | 11.78 |
| Mileage of pavements 60 ft. wide and over | 60.39 |
| Mileage of double pavements | 112.90 |
| Total | 332.52 |

In this tabulation, city streets and boulevards not in the county or state highway system are not included. The divided highways are of two types: one of these, the superhighway type, provides for double roadways with a central reservation for a contemplated rapid transit system; the other is the boulevard type which provides for double roadways with a landscaped central parkway area. Although these boulevard types were designed primarily as pleasure drives, they also serve as connecting roads between main arteries.

### Master plan of superhighways

The work outlined followed conventional lines of metropolitan road growth and of course still continues but about 1924 attention turned also to a parallel phase of development—superhighway planning. This was not a sudden thought; for some years county road planning had looked ahead to such a development. In a sense problems of right of way crystallized action.

The military roads laid out in 1825 were originally 100 ft. wide, but encroachments soon changed them back to wagon trails. The Governor and Judges' Plan of the city of Detroit provided for wide streets and avenues, but that plan was never carried out and as the city expanded, subdivisions with narrow streets, have been permitted to be recorded. There was a decided change in the attitudes of the governing bodies in and around Detroit as the automobile industry became one of the leading industries in the country and the problems of motor transportation became more and more complex. This led to the creation of the Rapid Transit Commission in the city of Detroit; the adoption of the master plan of highways and superhighways by the Detroit common council; the passage of the superhighway bill by the Michigan legislature and its subsequent approval by the governor; and finally the creation of the Macomb-Wayne, and Oakland-Wayne superhighway commissions to put such a plan into operation. All of this occurred between July 4, 1923, and Dec. 11, 1925, and the execution under these commissions has been very rapid.

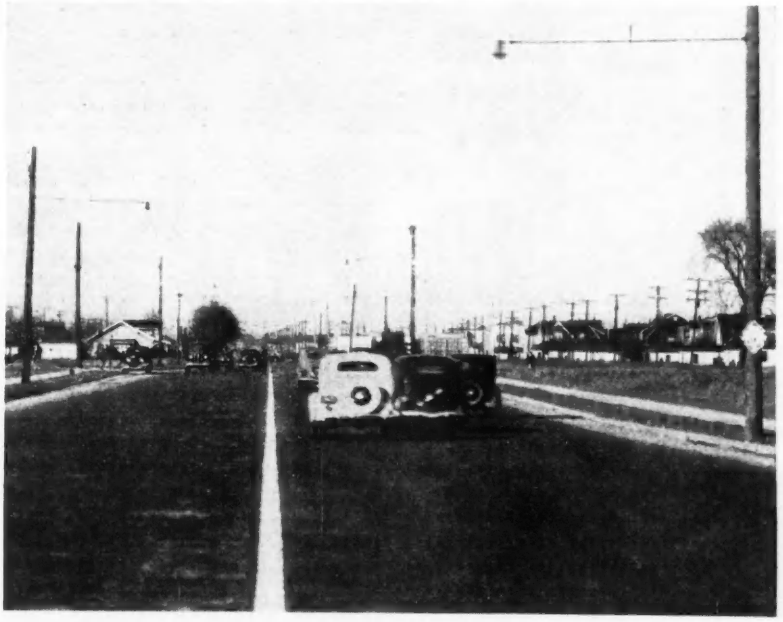


**Fig. 3.** Formerly two strips of concrete pavement each 21 ft. wide; now a 60-ft. strip of asphalt on a concrete base carrying a permanent center line mark made up of white cement.

*General Plan*—The master plan as adopted provides for a 120-ft. highway on each section line and an 86-ft. highway on each quarter line. It further provides that at intervals of 3-mi. there shall be a 204-ft. superhighway. With the plan fully in operation, the ultimate minimum width of pavement will be 40-ft. on the 120-ft. and 86-ft. highways and double 40-ft. pavements on the superhighways. The plan for superhighways also calls for an 84-ft. reservation for future rapid transit lines.

On some of the superhighways traffic at present requires pavements only 20 ft. wide; this is laid out as the center twenty of a future forty. Northwestern Superhighway, constructed in such a manner, now demands an increase width to take care of the heavy volume of traffic and the widening of this highway to double thirties by the construction of a 10-ft. widening strip on the inside adjacent to the central reservation has recently been completed.

*Right-of-way*—Since the adoption of the master plan, as new areas are subdivided, the streets are dedicated in accordance with the plan. In other places the property owners received the plan so enthusiastically that they offered the additional rights-of-way required without cost. As a result many miles of right-of-way valued at several million dollars have been obtained at no cost to the taxpayers.

Despite this fact, a large amount of money is still being expended every year for right-of-way purposes. This is especially true in built-up communities such as Detroit, where buildings have been erected on narrow rights-of-way and where present day traffic requires a wide right-of-way. For superhighway planning definitely extends to cities.

More and more of the highway funds are being allocated to solve problems within cities and to eliminate so-called bottlenecks within

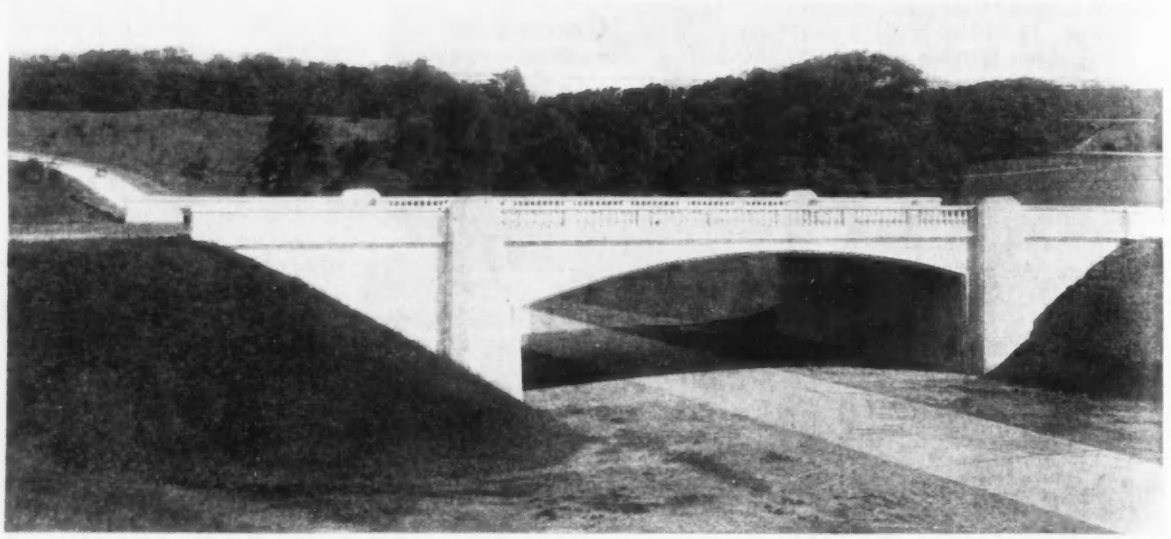


Fig. 4. Attractive grade separation structures providing for additional width are sought even on the two-lane roads.

municipalities. The county road commission is in an excellent position to solve these problems, because of its experience and organization, and because of its legal position whereby a continuation and completion of a definite plan beyond the limits of one municipality into and through the limits of other municipalities can be insured. As a result, superhighways are being extended into cities, and the master plan of highways can be applied to certain interior thoroughfares.

*Woodward Superhighway*—Recent construction work completed on Woodward Avenue in the city of Detroit is an example of this system of planning and development. In 1931, by purchase and condemnation, a strip of land 104 ft. wide was acquired on the west side of the 100-ft. right-of-way of Woodward Avenue between the Six Mile Road and the Base Line Superhighway, a section 2 mi. long. Woodward Avenue had already been made a superhighway 204 ft. wide in Oakland county from the Base Line Superhighway northerly to Pontiac. The existing pavement was 72 ft. wide with street railway tracks in the center.

The trolley tracks were removed and centered in the new 204-ft. right-of-way and the center portion paved. This 72-ft. pavement now serves northbound traffic, and cross-overs have been constructed at all street intersections. For southbound traffic a 60-ft. concrete pavement has been constructed. Although the superhighway section ends at the north limits of Highland Park, congestion at this point has been reduced due to the fact that Detroit traffic may turn off at three major arteries before reaching it.

The widening of the avenue through the business section of Detroit, from Grand Circus Park northerly to Grand Boulevard, a distance of about 3 mi., has also been completed. (*ENR* April 18, 1935). The major cost of this project was the right-of-way cost, the condemnation awards amounting to some $10,000,000. The new pavement, constructed on a 120-ft. right-of-way is 90 ft. wide and consists of a concrete base with sheet asphalt surfacing. Double car tracks are centered in the pavement, and a 15-ft. sidewalk has been constructed on each side.

*Jefferson Avenue*—One of the most important roads in the county is the road along the Detroit River, extending from the north limits of the county to the south. This is the oldest road in the state and was originally laid out during the war of 1812 as a military highway. At the present time sections of the road are known as East and West Jefferson avenues, Lake Shore Drive, and River Road. This road is an example of what may be accomplished in the way of extending an important thoroughfare through several municipalities.

The first sections of this road most recently rebuilt were those through the village of Grosse Pointe Shores and the Village of Grosse Pointe Farms, extending from the Wayne-Macomb-county line south, a distance of 4½ mi. This portion consists of two curbed strips of concrete pavement each 27 ft. wide with a 22-ft. parkway between them, centered on a 120-ft. right-of-way. The improvement replaces an 18-ft. pavement that was inadequate for existing traffic. A concrete seawall was built along the entire length of the pavement adjacent to Lake St. Clair. The completion of this project gave the people of Wayne county one of the most beautiful municipal drives in the county. The road is well lighted and landscaped.

Another section through the village of Grosse Pointe Park having a pavement 84 ft. wide was constructed in 1936. This section is through a concentrated business district and is of sheet asphalt on an 8-in. concrete base. A section 7 mi. long through industrial River Rouge, Ecorse, and Wyandotte is being constructed and is rapidly nearing completion. The pavement is of concrete centered on a 120-ft. right-of-way and is 90 ft. wide through the business section of River Rouge and 80 ft. wide elsewhere.

With the development of wider and better roads for more travelers came the necessity of operating these roads to conserve the time and safety of these travelers. How this need is being met is told in a concluding article to be published.

# Fundamentals of Apprentice Training

***Basic problems in a program to replenish the diminishing supply of skilled construction labor discussed at Associated General Contractors' meeting***

*Construction is facing a serious shortage of skilled labor, already evident during the past year or so. The training of new workmen to build up the thinning ranks of construction mechanics is imperative, otherwise the industry will be throttled by lack of man-power. The apprentice problem is a joint responsibility of employer groups, labor organizations and public agencies. Recognizing their responsibility, the Associated General Contractors have appointed a committee to study the problem. Wm. Joshua Barney, New York building contractor and chairman of the A.G.C. committee on apprenticeship, outlined a fundamental approach to the apprentice question at the association's board meeting in Atlantic City on Oct. 22. Following is an abstract of the committee's report.*

—EDITOR

EMPLOYMENT in the construction industry is usually intermittent and employee personnel is constantly changing. It is, therefore, difficult for any continuing or extensive apprenticeship plan to operate successfully on the traditional basis of indenture, agreements between a specific employer and a definite apprentice. Practically all apprentice plans call for a training period of two to four years. Few employers in the construction industry are willing to obligate themselves to guarantee continuous employment for so long a time.

It has therefore become necessary to resort to group responsibility for the guaranteeing of long term employment required to properly educate and train apprentices. Conversely, it has been found desirable for labor groups to assume the responsibility of seeing that the apprentice fulfills his obligations both as to the actual work and as to studies.

It is possible to envision a group of employers setting up an apprentice plan whereunder collectively they would assume the obligations as to employment by transferring apprentices from one member to another without any corresponding labor authority to control and regulate the apprentice. However, experience seems to indicate that such procedure generally breaks down, especially during periods of slack work, as each individual apprentice without some agency for collective bargaining or representation is helpless to enforce his rights against a group of employers. Therefore, the first requisite for the successful operation of an extensive apprentice plan is an equal participation and control by a responsible employer group and a responsible or organized labor group.

### Six fundamental features

In respect to the general principles of any apprentice plan, there are six features that seem fundamental:

1. On the employer's side should be a responsible group who will assume collective responsibility for whatever continuity of employment is regarded as necessary for the apprentice's training. Practical experience has shown where extensive apprenticeship work is undertaken this employer group should set up a secretary or manager who would assign the apprentices to the various member employers having work, such assignment to be in some definite ratio to the number of skilled mechanics employed on each particular operation. These assignments should work automatically. For example, if an employer has ten master mechanics, he should be obligated to take one apprentice for every such ten skilled mechanics. Then as the operation required less skilled mechanics, for each ten dropped one apprentice should automatically be returned to the employment secretary to be reassigned to another project. Unquestionably, in many localities there would not be enough apprentices in any one given trade to support an exclusive unemployment bureau for each trade. Consequently, this bureau would probably have to be set up to correlate and distribute employment for several apprenticeship plans in one locality.

In this connection, some authorities have suggested that the expense of such an employment bureau might well be borne in part at least by the apprentices themselves through requiring them to pay a modest registration fee of say $15 to $25 per year from their earnings.

2. The wages of the apprentice should bear some definite percentage ratio to the wages of his master mechanic, starting with a lower percentage in the first year and gradually increasing each year for the term of apprentice employment until the apprentice arrives at the status of a skilled mechanic and a skilled mechanic's wage. Regarding the question of wages, W. K. Smith, secretary of the Apprentice Committee of the Building Trades Employers' Association of New York, makes the following interesting observation: "The apprentice should be as fully employed as possible and every endeavor should be made to keep him at work. His term of indenture should be determined by days worked rather than by a yearly term, and his maximum earnings should be determined as, say, one-third of an estimated average annual wage of a journeyman. If, due to the apprentice's more continuous work, he should earn more than this annual sum, this difference would be turned back into the union. In this way very definite objections of the unions would be met relative to the displacement of journeymen by apprentices."

3. The employer group should have as a party to the indenture agreement not only the apprentice but also some organized group or union local of

Union Building Trades Membership, New York
1926-30=100
(115,000 members)
6 year decline @ 5%
1936 membership
70% of 1929
New York building permits
Increasing decline
Estimated
Compiled by Building Trades Employers Ass'n, New York City
Building Permits - Millions of Dollars
Building Trades Membership - Per Cent of 1926-30
1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940

**Need for apprentice training is shown graphically by comparing the New York building volume with the supply of skilled tradesmen. On the basis of full employment and adequate supply of building trades workers in 1926-30, the current decline in available mechanics will result in a critical situation in 1938, growing worse thereafter.**

the master mechanics to which the apprentice is looking for membership and a working card when his period of training is completed. The labor group should be specifically obligated to see that the apprentice complies with the terms of his indenture in the matter of discipline, application of his work, attendance in the training school or night classes. Also a probationary period should be stipulated during which time the employer or the apprentice may cancel the indenture.

4. The employer and the labor groups together should set up a course of studies to be pursued by the apprentice, who, under the indenture, should be obligated satisfactorily to pursue them. Depending upon local conditions, these scholastic facilities may be provided by some established trade school or through the cooperation of public school authorities who are usually willing to provide classrooms and even teachers. The federal government has set up an elaborate nationwide system for cooperation in providing these educational facilities.

Fortunately, in all states there are available state and federal funds for this purpose. The federal government since 1917 has been matching state and local funds dollar for dollar in the maintenance of these programs through the provisions of the Smith-Hughes Act. This year there are available additional funds under the George-Deen Act in the amount of $12,000,000.

5. Where the cooperation and partnership of a labor group has been secured, the indenture should clearly provide that if the apprentice satisfactorily completes both his practical and his scholastic training the labor group will grant him full membership and a working card in its organization.

6. It may also be desirable in the apprentice plan to set up certain minimum requirements of qualification by the candidate for apprenticeship training, such as age limits, at least a common school education, and possibly some qualifications as to citizenship and a declaration of aptitude or liking for the particular work in which the apprentice is to be trained.

Obviously it is essential for the successful working of any extensive apprentice plan for such plan to be a joint enterprise of the employer and labor, having as a common objective the honest training of apprentices into efficient mechanics. Otherwise there is also the probability that such a plan will be regarded by labor as an employer's scheme to obtain employees at less than the prevailing wages.

From statistics and other general information there is little doubt that in many sections of the country there is urgent need for stimulating interest in the training of apprentices in the skilled crafts and trades if the construction industry is to avoid a very definite shortage of skilled mechanics. The Building Trades Employers' Association of New York has made an extensive survey along these lines and has summarized its findings in an interesting chart, a copy of which is shown.

### Urgent need for apprentices

With the widespread movement and drive for the organizing of labor throughout the country, it is not difficult to conceive that ultimately, if not in the near future, practically all labor will be affiliated with some form of organization. On the other hand, there are a number of communities in which organized labor is not yet represented and where it may be undesirable from the employers standpoint to seek out or create labor organizations in connection with the apprentice plan. Here it may be necessary to devise apprenticeship plans in which labor is not represented. In such cases, however, there is little question that there should be some third party to the plan in addition to the employer and the apprentice to see that the mutual rights and obligations of the latter two are properly and clearly carried out. Such a third party might well be some federal agency or a representative of the local educational authorities contributing to the scholastic part of the apprentice's training.

• • •

## British Express Highway

PLANS for a 54-mile express highway, to cost from $25,000,000 to $30,000,000, through Lancashire, England, have been approved by the Lancashire County Council, and steps are being taken to secure the approval of the central government. The trunk highway, running north and south through Lancashire, will bypass four towns and bridge the Rivers Lune and Ribble and the Manchester ship canal.

The project is expected to take about three years to complete. It is hoped that similar projects in the counties of Cheshire and Westmoreland can be linked with the Lancashire scheme.

# Scenic Road Traverses California Sierras

***High-altitude recreational highway along the Sierra Nevada is being developed from separate road building projects largely in national forests***

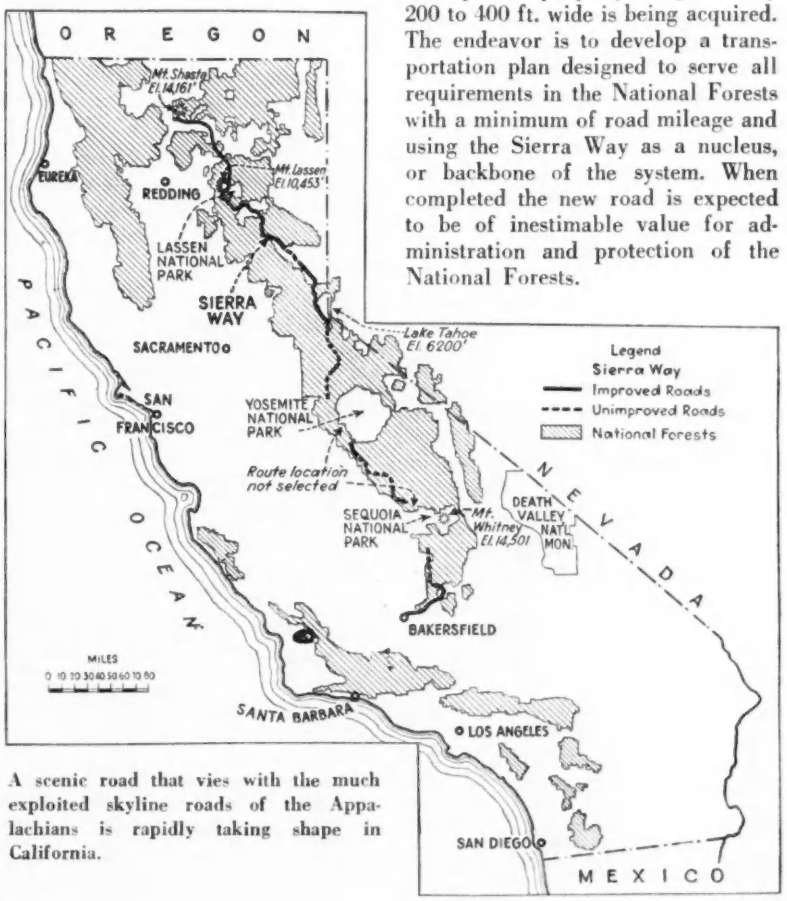
A SCENIC HIGHWAY 780 mi. long and for most of its length through the national forests of the Sierra Nevada Mountains in California is planned to extend from Mount Shasta in the north to Kern River in the south. Much of the proposed route is at elevations of about 5,000 ft., with occasional rises to 7,000 or 8,000 ft. in mountain passes. The route traverses a volcanic region near Mount Lassen, passes historic Donner Lake, as well as Lake Almanor, one of the world's largest artificial lakes, and for 20 mi. follows the shores of Lake Tahoe at El. 6,200 ft. Through its entire length the route connects points that have become a great lure to travel public and at the same time it improves access to points of strategic value in forest administration.

A fundamental of the plan is that the project is not to be extremely expensive. The idea is not to build on a new location through remote regions; on the contrary, about 80 per cent of the proposed route was at least passable to traffic when the project originated. Essentially, the idea is to coordinate improvements to existing roads and locations of new projects so that these expenditures will fit into the plan of ultimately having a high-grade highway of uniform standards suitable for through traffic along the selected route. This general plan can be followed even though completion of certain portions of the route are not possible for some years. Under the unified plan, when it becomes necessary to improve any of the old roads they are relocated and designed to modern highway standards and adopted as a part of the Sierra Way.

At the outset a check of the situation along the proposed route disclosed that more than 60 different agencies were proposing or actually were constructing roads through the area affected. These agencies included public and private interests, lumbering, mining, agricultural companies, and federal, state or county departments or bureaus. A plan to coordinate all of these in the interest of the public and the administration of national forests has been the policy of the Forest Service in recent years in controlling and coordinating what otherwise would be indiscriminate road construction.

The major portion of the Sierra Way already has taken definite form; at the north end the 300 mi. from Mount Shasta to the southern end of Lake Tahoe is completed, or early construction is assured. On the next 100 mi location surveys have been made and accepted. About 30 mi. of this section is over existing highways of satisfactory standard and about 10 mi. additional is under construction. Of the remaining 380 mi. location is partly fixed by existing roads of which 120 mi. is of acceptable standard. Some portions of this part of the route have not been located because of the necessity for studying and comparing several possible alternate routes.

The U. S. Forest Service has set aside a right-of-way 400 ft. wide over the National Forest lands to be given special aesthetic treatment. Over private property a right-of-way 200 to 400 ft. wide is being acquired. The endeavor is to develop a transportation plan designed to serve all requirements in the National Forests with a minimum of road mileage and using the Sierra Way as a nucleus, or backbone of the system. When completed the new road is expected to be of inestimable value for administration and protection of the National Forests.




A scenic road that vies with the much exploited skyline roads of the Appalachians is rapidly taking shape in California.

# Flood Runoff from Small Areas

by Victor H. Cochrane
Consulting Engineer, Tulsa, Okla.

*New formulas eliminate inaccuracies which result when most formulas are applied to small areas of drainage*

There is need for a better understanding of the factors affecting flood discharge, particularly in relation to small watersheds. Of the numerous flood-flow formulas that have been proposed very few are applicable to small drainage areas, and some give values ten to twenty times too small for extreme cases of intense precipitation and quick runoff.

For making approximate estimates of flood discharge and comparing one watershed with another, it is desirable to have a formula containing all of the principal factors and applicable to even the smallest areas. The formulas here presented attempt to meet these requirements. They are based on the variation in the rate of precipitation with respect to time, and they give results approximating those obtained by the use of the so-called rational method.

## Rainfall

Maximum floods in small watersheds are produced by rainfall of the cloudburst type. The intensity of precipitation for a period of two hours or less is usually given by an expression of the form $i = \frac{A}{t + B}$, in which $i$ is the average intensity for $t$ min., and $A$ and $B$ are constants for a particular condition. In "Elements of Hydrology," p. 181, Meyer gives 35 formulas of this type covering seven frequencies of from 1 to 100 years for five groups of observation stations. In these formulas $A$ varies from 60 to 600, and $B$ from 13 to 65.

If we let $I$ = the value of $i$ for a period of 60 min., and put $A = 60\ I + nI^2$ and $B = p\ I$, we have

$$i = \frac{60\ I + nI^2}{t + pI}.$$

In this expression the coefficients have a much smaller range of values than those in the Meyer formulas. If we assume $n = p = 10$ (an average value), we have the formula

$$i = \frac{60\ I + 10\ I^2}{t + 10\ I} = \frac{60 + 10\ I}{\frac{t}{I} + 10} \qquad (1)$$

This formula fits the original data almost as well as do the 35 expressions previously mentioned. Table I shows comparative results for Meyer's Group 2.

For storms of longer duration the precipitation other than that occurring in the two hours of maximum intensity may be calculated from a formula of the exponential type. Merrill M. Bernard in *Transactions* Am. Soc. C. E., Vol. 96, p. 618, presents the formula

$$i = \frac{K\ F^x}{t^n},$$

in which $K$ is a constant, $F$ a probability factor, and $x$ and $n$ exponents varying slightly according to locality. If $n$ is given the average value 0.75, the total precipitation in 24 hr. will be 1.87 times that in 2 hr. By combining the two formulas we have values for $I = 5$ as shown in Table II.

For the present purpose it will be sufficiently accurate to assume that for other values of $I$ the rates of precipitation will be proportional to those in Table II. Thus, if the total precipitation in 24 hr. is 6 in., the corresponding value of $I$ is 6/12 x 5, or 2.5 in. If it is known that 6.5 in. fell in 6 hr., $I$ may be assumed equal to 6.5/8.51 x 5, or 3.8 in. This procedure is based on the assumption that there is a fairly definite relationship between the precipitation for a given period and the maximum for a lesser period. This assumption seems to be well supported by the existing records of intense precipitation.

In any actual storm the periods of maximum intensity will occur at irregular and unpredictable intervals. The type of storm most likely to produce high rates of runoff is that in which the maximum intensities are grouped about a single peak in the middle of the storm period, as shown in Fig. 1. If it is assumed that the maximum possible runoff from a small area cannot exceed that due to the average precipitation rate for a

TABLE I — INTENSITIES FOR GROUP 2 ACCORDING TO MEYER AND AS COMPUTED FROM EQUATION NO. 1

| | | Rate in inches per hour for precipitation in a given number of minutes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency in Years | Formula | 5 | 10 | 15 | 30 | 45 | 60 | 80 | 100 | 120 |
| 2 | Meyer | 5.04 | 4.26 | 3.64 | 2.58 | 1.98 | 1.62 | 1.30 | 1.08 | 0.93 |
| | Eq. 1 | 5.82 | 4.71 | 3.96 | 2.67 | 2.02 | 1.62 | 1.28 | 1.06 | 0.91 |
| 5 | Meyer | 6.00 | 5.10 | 4.44 | 3.20 | 2.50 | 2.05 | 1.65 | 1.39 | 1.19 |
| | Eq. 1 | 6.47 | 5.41 | 4.65 | 3.27 | 2.52 | 2.05 | 1.64 | 1.37 | 1.17 |
| 10 | Meyer | 6.85 | 5.94 | 5.20 | 3.82 | 3.02 | 2.50 | 2.02 | 1.70 | 1.46 |
| | Eq. 1 | 7.09 | 6.08 | 5.32 | 3.87 | 3.04 | 2.50 | 2.02 | 1.70 | 1.47 |
| 50 | Meyer | 8.28 | 7.26 | 6.48 | 4.80 | 3.85 | 3.20 | 2.63 | 2.22 | 1.93 |
| | Eq. 1 | 7.96 | 7.02 | 6.27 | 4.75 | 3.82 | 3.20 | 2.63 | 2.23 | 1.94 |
| 100 | Meyer | 8.76 | 7.80 | 6.92 | 5.26 | 4.22 | 3.53 | 2.90 | 2.46 | 2.14 |
| | Eq. 1 | 8.35 | 7.43 | 6.69 | 5.15 | 4.19 | 3.53 | 2.92 | 2.49 | 2.17 |

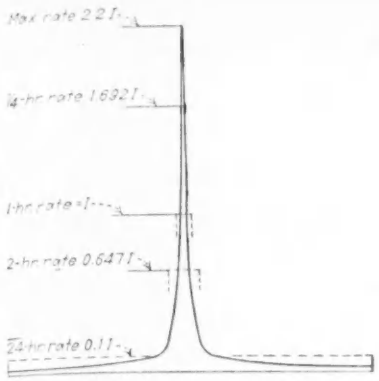



Fig. 1. Assumed rainfall intensities for small drainage areas

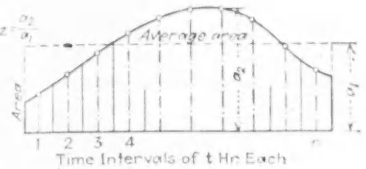



Fig. 2. Typical time-area diagram

TABLE II — RAINFALL INTENSITIES FOR $I = 5$

| Time in Hr. | Average precipitation for the period: Percentage of $I$ | Average precipitation for the period: Intensity in inches | Total for the period, inches |
|---|---|---|---|
| ½ | 169.2 | 8.46 | 2.12 |
| 1 | 100.0 | 5.00 | 5.00 |
| 2 | 64.7 | 3.24 | 6.47 |
| 3 | 47.7 | 2.39 | 7.16 |
| 4 | 38.5 | 1.92 | 7.69 |
| 5 | 32.5 | 1.63 | 8.13 |
| 6 | 28.4 | 1.42 | 8.51 |
| 8 | 22.9 | 1.14 | 9.15 |
| 12 | 16.9 | 0.84 | 10.1 |
| 24 | 10.0 | 0.50 | 12.0 |

short period, say ¼ hr., the maximum runoff from small areas in sec.-ft. per sq. mile is given by the formula

$$q = 1.692 \times 645\ cI = \text{say } 1{,}100\ cI, \qquad (2)$$

in which $c$ is the ratio of runoff to precipitation. The proposed flood-flow formula is based on this value of $q$ for zero area. It will be seen that Eq. 2 is an adaptation of the rational formula.

The assumed distribution is more severe than would likely occur, but on the other hand the storm might move down the valley in such a way as to increase the peak runoff. It is recognized that as the area increases, the precipitation, in effect, becomes more nearly uniform.

## Watershed characteristics

At the time of maximum discharge at the outlet the flow is made up of increments arriving from different parts of the watershed in various times. The total catchment area may be divided into time-area zones whose contributions arrive at the outlet in equal time intervals. The relative areas of the zones will depend chiefly upon the shape of the watershed, the pattern and condition of the stream channels, and the topography of the ground. Fig. 2 shows a typical time-area diagram. In the figure, $z$ is the ratio of the maximum area $a_2$ to the average area $a_1$. For non-uniform rainfall of the type shown in Fig. 1 the maximum flow will generally occur when the contribution from the maximum area $a_2$, due to the most intense precipitation, arrives at the outlet. It will be seen that if the precipitation is uniform in intensity over the watershed during the time of concentration the flow is the same regardless of the relative areas of the zones. That is, the maximum flow from a watershed of unequal zone-areas at a constant precipitation rate is the same as that from the same size watershed with equal zone-areas, at a variable rainfall rate of the same average value.

If $L$ is the length of the main stream in miles, measured along the axis of the valley (neglecting sinuosities), $n$ is the number of zones, $t$ is the time interval per zone in hours, $T$ is the time of concentration ($=nt$), and $V$ is the average velocity of the flood-wave along the valley axis in mi. per hr., we may write:

$$V = \frac{L}{nt} = \frac{L}{T}.$$

The term $V$ is the net result of all of the physical characteristics of the drainage area and the stream channels, except such as are reflected in the runoff coefficient $c$. In practice $V$ is to be estimated by considering a number of typical reaches of the main stream. At any section of the stream the average velocity $v$ (in ft. per sec.) may be estimated by the use of the Chezy formula with appropriate values of the terms therein. If $V_1$ is the velocity of movement in mi. per hr. along the valley axis in any particular reach, and $v_1$ is the corresponding channel velocity in ft. per sec., we have the relation

$$V_1 = \frac{v_1}{1.47\, f_1},$$

in which $f_1$ is the sinuosity factor, or ratio of stream length to valley length.

In estimating $V$ allowance should be made for the slowing up caused by overbank flow. The result to be sought is the average rate of flow down the valley. It will be seen that while $V$ is not a factor to be determined or selected solely as a result of experience, some judgment will have to be exercised in arriving at a proper value.

Ordinarily the slope of the stream bed increases towards the source while the cross-sectional areas decrease, so that the velocities tend to remain fairly uniform. It would seem therefore that the average value $V$ is a reliable measure of the flood discharge.

If $M$ is the drainage area in sq. mi. and $W$ is the mean width,

$$W = \frac{M}{L}.$$

If $b$ is the ratio of length to mean width,

$$b = \frac{L}{W} = \frac{L^2}{M}$$

## Flood formula

It is a simple matter to compute the discharge rates for drainage areas having various shapes and length-width ratios for various values of $V$, using the rainfall rates of Fig. 1 or Table II. Table III shows the computation of flows due to 100 percent runoff for the rainfall rates of Fig. 1 ($cI = 5$). In this case $M = 32$, $L = 8$, $W = 4$, $b = 2$, $V$

TABLE III — TYPICAL COMPUTATION OF FLOOD-FLOWS

| Runoff in inches per hour | $a_2 = 8$, Area of zone in sq. mi. | $z = 2$ Total flow, sec.-ft. | $a_2 = 6$, Area of zone in sq. mi. | $z = 1.5$ Total flow, sec.-ft. | $a_2 = 4$, $z = 1$ |
|---|---|---|---|---|---|
| 2.25 | 1.0 | 1,400 | 1.8 | 2,600 | |
| 3.10 | 2.1 | 4,200 | 3.2 | 6,400 | |
| 4.33 | 3.6 | 10,000 | 4.6 | 12,800 | |
| 6.58 | 5.9 | 25,000 | 5.8 | 24,600 | |
| 9.57 | 8.0 | 49,400 | 6.0 | 37,000 | |
| 6.58 | 6.5 | 27,600 | 5.0 | 21,200 | |
| 4.33 | 3.4 | 9,500 | 3.5 | 9,800 | |
| 3.10 | 1.5 | 3,000 | 2.1 | 4,200 | 4.0 x 645 x 39.84 |
| 39.84 | 32.0 | 130,100 | 32.0 | 118,600 | = 103,000 |
| $q$= | | 4,060 | | 3,710 | 3,220 |

TABLE IV — VALUES OF q, K, Kz, AND a WHEN M = 32, L = 8, W = 4, b = 2, cI = 5

| V | z = 2.0 | | | | z = 1.5 | | | | z = 1.0 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | q | K | Kz | a | q | K | Kz | a | q | K, Kz | | a |
| ∞ | 5,500 | | | | 5,500 | | | | 5,500 | | | |
| 8 | 4,060 | 2.83 | 5.66 | 0.71 | 3,710 | 3.88 | 5.82 | 0.73 | 3,220 | 5.66 | | 0.71 |
| 4 | 2,920 | 3.53 | 7.06 | 0.88 | 2,550 | 4.64 | 6.96 | 0.87 | 2,085 | 6.53 | | 0.82 |
| 2 | 1,915 | 3.74 | 7.48 | 0.93 | 1,600 | 4.87 | 7.30 | 0.91 | 1,235 | 6.90 | | 0.86 |
| 1 | 1,170 | 3.70 | 7.40 | 0.92 | 965 | 4.70 | 7.05 | 0.88 | 735 | 6.50 | | 0.81 |
| 0 | 0 | | | | 0 | | | | 0 | | | |

= 8, and the average zone-area $a_1$ = 4. The zone-areas other than the maximum are arbitrarily assumed. The maximum rate of precipitation is applied to the largest zone. It is assumed that the time required for the waters to concentrate at the nuclei of the several zones is the same for each zone, hence this period is not a factor in the computation.

These results, and all others calculated in this manner, are equal approximately to the assumed maximum runoff (Eq. 2) times the reduction factor $\frac{V}{V+K}$. That is,

$$q = \frac{1,100\,cIV}{V+K} = \frac{1,100\,cI}{1+\frac{K}{V}}. \qquad (3)$$

$K$ is nearly constant for a given set of conditions, as may be seen from Table IV, which is typical.

Considering two watersheds of the same time-zone pattern ($b$ and $z$ equal), it is evident that if $V$ is kept proportional to a linear dimension, as the length $L$, values of $q$ will be the same. Thus, referring to Table III, it will be seen that if $M = 8$, $L = 4$, $V = 4$, the zone areas and the total runoff will be one-fourth as great as shown, and the flow $q$ per sq. mi. will be the same.

From Eq. 3, if $q$ is constant and $V$ varies as $L$, $K$ must also vary as $L$. Also, it appears from Table IV and other similar calculations that $Kz$ is nearly constant for a given drainage area with the length-width ratio $b$ constant; that is, $K$ varies approximately inversely as $z$. Hence, since

$$b = \frac{L^2}{M} \text{ and } L = \sqrt{Mb},$$

$$K = \frac{cL}{z} = \frac{a\sqrt{Mb}}{z}, \qquad (4)$$

in which $a$ is a constant.

In Table IV, which is typical, $a$ varies from 0.71 to 0.93. Assuming an average value of 0.85 and combining Eq. 3 and 4, we have:

$$q = \frac{1,100\,cI}{1+\frac{0.85\sqrt{Mb}}{Vz}} = \frac{1,100\,cI}{1+\frac{0.85L}{Vz}} = \frac{1,100\,cI}{1+\frac{0.85T}{z}}, \qquad (5)$$

in which $q$ = the flood discharge in sec.-ft. per sq. mi. of drainage area;

$c$ = the runoff factor, or ratio of runoff to rainfall;

$I$ = average intensity of maximum precipitation for the aggregate period of one hour during a given storm;

$M$ = area of watershed in sq. mi.;

$W$ = mean width of watershed in mi. $= \frac{M}{L}$;

$b$ = ratio $\frac{L}{W} = \frac{L^2}{M}$;

$V$ = average velocity of water along axis of valley in mi. per hr.;

$z$ = ratio of maximum to average area of zones of equal time-intervals (or, approximately, the ratio of maximum width of watershed to the mean width $W$);

$T$ = time of concentration in hr., $= nt = \frac{L}{V}$

It appears from the third form of the expression for $q$ in Eq. 5 that $T$ is the principal factor determining $q$. It is now seen that Eq. 5 may be derived at once from the precipitation formula

$$i = \frac{1.70\,I}{1+0.85\,T},$$

which gives approximate values of $i$ in terms of $T$.

For precipitation of uniform intensity,

$$q = 645\,c = \frac{1,100\,cI}{1+0.85\,T}.$$

Inserting $z$ in this expression, we have the third form of Eq. 5, from which the other forms may be derived.

As stated above, the precipitation may be more accurately represented by using a hyperbolic formula covering a period of 2 hr. or less, and an exponential formula for longer periods. Also, we may regard $q$ as proportional to the sum of two factors: $A$, expressing the average rate of rainfall, and $B$, expressing the increment due to non-uniform precipitation and the shape of the watershed. $B$ is equal to zero for $T = 0$, or $M = 0$, or $z = 1$. The empirical expression for $B$ given below fits the calculated flood flows very well. We have, therefore,

$$q = cI\,(A+B), \qquad (6)$$

in which $A = \frac{1,400}{1+1.2\,T}$, for $T = 2$ hr. or less,

or $A = \frac{700}{T^{0.75}}$ for $T$ greater than 2 hr.;

$$B = 100\,(z-1)\,\frac{6\sqrt{T}-T}{2+T};$$

and $T = \frac{L}{V} = \frac{\sqrt{Mb}}{V}$.

(The exponential form is used for periods greater than 1 hr. in order to make $A$ a continuous function. The exponent of $T$ may have any desired value other than 0.75)

Eq. 5 is more convenient than Eq. 6, and it gives substantially the same results, except for very small or very large values of $T$.

If the flow due to a uniform rate of precipitation is desired, $z$ should be taken as unity in Eq. 5 and $B$ as zero in Eq. 6.

$$z_1 = \frac{2z+\sqrt{M}}{2+\sqrt{M}}. \qquad (7)$$

On watersheds of considerable size the average precipitation may be materially less than the maximum occurring at a single point or over a small part of the drainage area. The average should be used in determining the value of $I$ to substitute in the formula. The runoff coefficient $c$ relates to the immediate surface runoff; that part of the runoff that is delayed by pondage or percolation is to be disregarded.

It is believed that the formulas are substantially correct in form, although the constants may need some

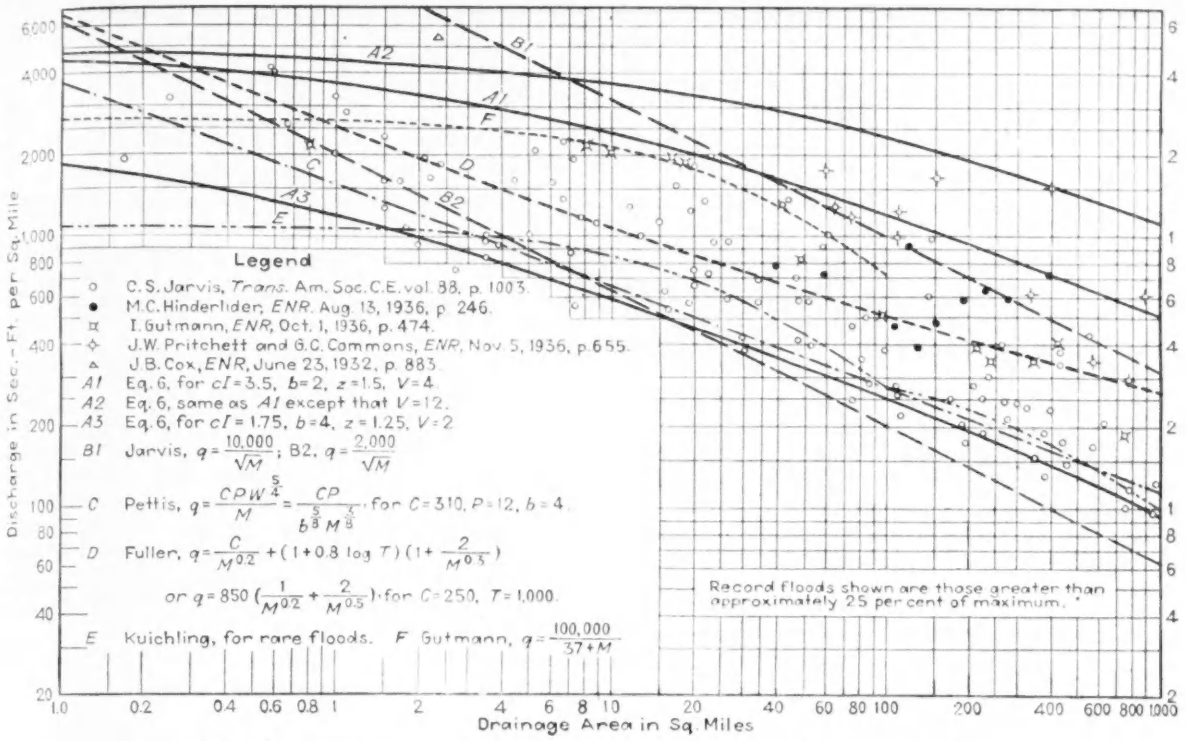

Discharge in Sec.-Ft. per Sq. Mile
Drainage Area in Sq. Miles
Legend
C. S. Jarvis, Trans. Am. Soc. C.E. vol. 88, p. 1003.
M. C. Hinderlider, ENR, Aug. 13, 1936, p. 246.
I. Gutmann, ENR, Oct. 1, 1936, p. 474.
J. W. Pritchett and G. C. Commons, ENR, Nov. 5, 1936, p. 655.
J. B. Cox, ENR, June 23, 1932, p. 883.
A1 Eq. 6, for cI = 3.5, b = 2, z = 1.5, V = 4.
A2 Eq. 6, same as A1 except that V = 12.
A3 Eq. 6, for cI = 1.75, b = 4, z = 1.25, V = 2.
B1 Jarvis, q = 10,000/√M; B2, q = 2,000/√M
C Pettis, q = CPW^5/4 / M = CP / b^3/8 M^5/8, for C = 310, P = 12, b = 4.
D Fuller, q = C/M^0.2 + (1 + 0.8 log T)(1 + 2/M^0.5)
or q = 850 (1/M^0.2 + 2/M^0.5), for C = 250, T = 1,000.
E Kuichling, for rare floods. F Gutmann, q = 100,000/37 + M
Record floods shown are those greater than approximately 25 per cent of maximum.

**Fig. 3.** Flood discharge records related to drainage areas and various formulas

modification. From Eq. 5, for $M = 0$, or for $V =$ infinity (instantaneous concentration), $q = 1{,}100\ cI$, the assumed maximum possible runoff. If $V = 0$, as for a perfectly flat plain, $q = 0$. For areas large enough to permit of the dropping of the first term of the denominator, the formula reduces to

$$q = \frac{1{,}300\ \frac{cIVz}{\sqrt{b}}}{\sqrt{M}}.$$

This is the same form as the modified Myers formula proposed by C. S. Jarvis in *Transactions* Am. Soc. C. E., Vol. 89, p. 994, in which the numerical value 10,000 is the maximum corresponding to the numerator in the above expression. It is evident that 10,000 is too large for very small areas, and under extreme conditions it is too small for larger areas, as may be seen from Fig. 3.

### Examples

Published accounts of floods do not as a rule give data from which $V$ can be computed. As far as the writer is able to judge, all cases of moderate and extreme flood flows can be accounted for with reasonable values of $I$, $c$, and $V$. The Olmos Creek flood at San Antonio, described by Terrill Bartlett in *Transactions* Am. Soc. C. E., Vol. 85 (1922), was a case of a high rate of runoff from a small area. It appears that the mean velocity in the cross-section of the stream was approximately 7 ft. per sec., so that allowing for pondage and sinuosity $V$ was about 3.0 miles per hr. The average rainfall was something like 12 in. in 24 hr., making $I = 5$ (Table II). Other terms are assumed as follows: $c = 0.70$, $L = 10.8$, $M = 32.4$, $W = 3.0$, $b = 3.6$, $z = 1.2$. From Eq. 5 we have

$$q = \frac{1{,}100 \times 5 \times 0.70}{1 + \frac{0.85 \times 10.8}{3.0 \times 1.2}} = 1{,}085 \text{ sec.—ft.}$$

From Eq. 6, $q = 961$. The flow was estimated to be between 900 and 1,200 sec. = ft., with 960 as the most probable value.

For values of the various terms favorable to runoff the resulting values of $q$ when plotted on a chart showing recorded flood flows, follow closely the trend of maximum floods, as indicated by curve $A1$ of Fig. 3. Curves $A1$, $A2$, and $A3$ are computed from Eq. 6 for typical values of the terms. The recorded flows are as given by the authorities named. Lines representing other formulas are shown in comparison with the actual floods and curves $A1$–2–3.

. . .

## Municipal Job Control Improved in St. Paul

A FORWARD step toward stabilizing employment conditions in its classified civil service has been taken by St. Paul, Minn., with the city council's adoption of an ordinance that limits the appointing power of department heads, according to J. B. Probst, chief examiner of the St. Paul Civil Service Bureau.

The ordinance, which embodies 13 organization charts showing the distribution of functions, lines of authority, etc., for each department, limits job appointments to the number and titles listed, except in an emergency, when twice the employees may be hired. For fifteen years, writes Examiner Probst in a recent issue of *Public Management*, magazine of the International City Managers' Association, it has been the practice to permit appointing officers to make whatever appointments they deemed necessary for the proper conduct of their departments.

# Rigid-Frame Rocker Bents

by C. D. GEISLER

Highway Bridge Engineer, U. S. Bureau of Public Roads

***Blue Ridge Parkway viaduct with continuous I-beam deck is supported on rigid frame bents for the sake of appearance***

A VIADUCT with continuous I-beam spans supported on rigid-frame rocker bents was adopted as the most suitable type for the first of a number of viaducts to be built on the Blue Ridge Parkway, the new scenic route extending for a distance of 460 miles along the crest of the Blue Ridge Mountains and connecting the Skyline Drive in Shenandoah National Park in Virginia with roads improved in the last few years in the Great Smoky Mountains National Park in Tennessee. The route will be an outstanding attraction for tourists who already throng the Skyline Drive, and esthetic considerations are of first importance in all features pertaining to the highway.

The first rigid frame bent viaduct has been erected over Big Pine Creek in Alleghany County, North Carolina, and similar designs are being prepared for other locations. The structure, continuous for the 235 ft. of total length between end bearings, consists of five right-angle 47-ft. steel I-beam spans. The roadway has a 21-ft. clear width between curbs which is considered adequate to take care of the vehicular traffic expected within the economic life of the structure, as well as the occasional groups of hikers and a few strollers from parked cars. Because of the small number of pedestrians, sidewalks were considered unnecessary. The roadway floor consists of a 7½-in. reinforced concrete slab with allowance for a future 2-in. bituminous surface. The curb extends 1 ft. 7 in. above the pavement, and is provided with a concrete hand railing of posts and single precast horizontal rail. Five lines of 30-in. 108 lb. I-beams, spaced 6 ft. 2 in. apart, comprise the stringer system. All structural steel is painted a chrome green.

The structure is designed to carry a live load consisting of either the A.A.S.H.O. H-15 truck or lane loading with two loaded lanes, or the H-20 single truck concentration; both loadings including impact allowance.

### Choice of structure

In the ravine spanned by the viaduct, Big Pine Creek requires a waterway area of only 400 square feet. A spandrel-filled concrete arch would have met this requirement, but it was desired to preserve the adjacent trees and foliage and also the natural topography which would have been destroyed by a deep approach fill with its extensive side slopes. The established grade of the highway over the valley gave a maximum height of 38 ft. from ground to roadway.

The type of structure first considered was a single span steel ribbed arch. The topography of the ravine permitted a main span of 110 ft., with shorter unsymmetrical arch side spans or simple beam viaduct approaches for the remaining width of ravine. The steel ribbed arch type,

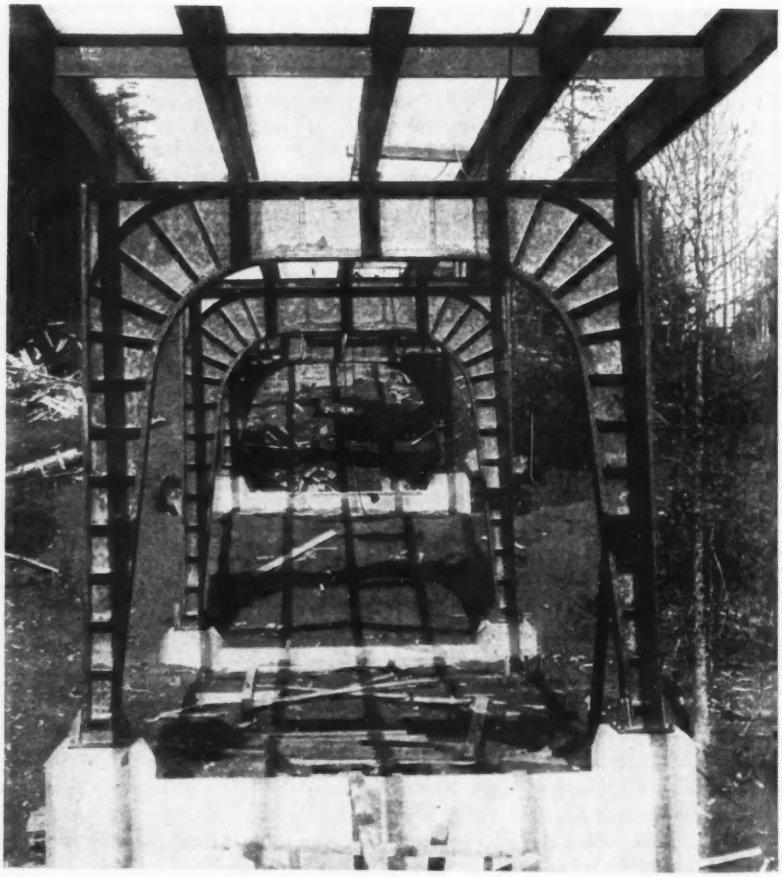


**Fig. 1.** Rigid frame bents set on pin bearings give special distinction to a new viaduct on the Blue Ridge Parkway.

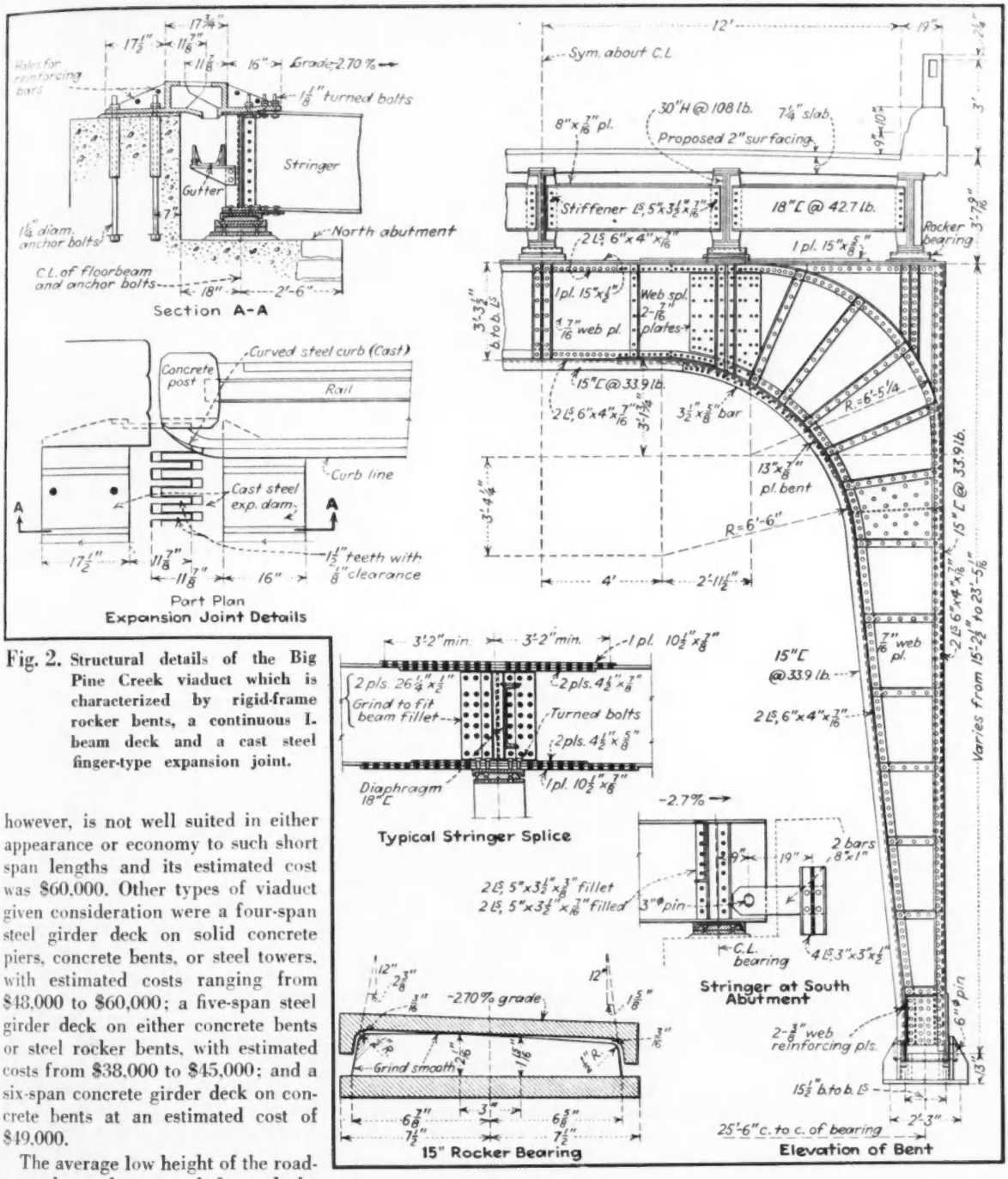



**Fig. 2.** Structural details of the Big Pine Creek viaduct which is characterized by rigid-frame rocker bents, a continuous I-beam deck and a cast steel finger-type expansion joint.

however, is not well suited in either appearance or economy to such short span lengths and its estimated cost was $60,000. Other types of viaduct given consideration were a four-span steel girder deck on solid concrete piers, concrete bents, or steel towers, with estimated costs ranging from $43,000 to $60,000; a five-span steel girder deck on either concrete bents or steel rocker bents, with estimated costs from $38,000 to $45,000; and a six-span concrete girder deck on concrete bents at an estimated cost of $49,000.

The average low height of the roadway above the ground favored the girder type deck of moderate span lengths supported on light piers or bents, and as the total length of viaduct was under 300 ft., a continuous structure on roller bearings or rocker-bents was selected because of its economy. A continuous deck structure from abutment to abutment also has the advantage in requiring only one expansion joint across the roadway. The preliminary estimate of the 5-span continuous I-beam deck on steel rocker-bents was under $40,000. This was later increased due to changes in the rocker-bent design, the addition of a cast steel expansion dam and to the upward trend in prices.

### Rigid-frame bents

The viaduct-bents were designed as rigid-frames to eliminate the usual sway bracing. The bents are built up of plates, angles and channels, the underside being arched to give a pleasing outline and a natural appearance of strength. The legs are set on pin bearings to permit rocking longitudinally with the structure. Cast steel shoes support the pins which are machined to exact fit with the lower ends of the columns to prevent side movement; they thus serve as abutments as well as vertical bearings and transmit the arch ac-

Fig. 3. Deck view of viaduct over Big Pine Creek on the Blue Ridge Parkway.

tion into the concrete bases. Lugs on the shoes project into the concrete footing and prevent lateral slippage on the masonry. The concrete piers consist of a pedestal under each shoe, with a reinforced concrete cross strut connecting the two pedestals to prevent any lateral displacement occurring under horizontal thrust from the frame. The pedestals thus transmit a uniform vertical load to the foundations through the spread footings upon which they rest.

Inasmuch as the deflection of the rigid-frame rooker-bent produces an eccentric load at the outer edges of the column footings, the bearings were designed to withstand the entire vertical load being transmitted through the outer flange of the legs or columns. The same allowance was made in the bearing of the shoes on the masonry.

In view of the uncertainty in getting the rocker bents erected to the degree of accuracy necessary to insure perfect rigid-frame action, the bents were also designed without considering the horizontal restraint of the footings except for wind load, for which condition a higher unit stress was permitted in the steel, but not exceeding 20,000 lb. per sq. in. under full dead and live loads. Although this conservative basis of design reduced the economy in material obtainable in true rigid-frame design, it was considered advisable to refrain from attempting to use the structural steel rigid-frame bent beyond its practical limitations. Each bent was fabricated in three sections, and was assembled and riveted in horizontal position before being lifted into place.

The total cost of the four rocker-bents, exclusive of cast steel shoes, was $4,500. This cost is comparable to that of concrete bents or light concrete arched piers, which would also have permitted the use of a continuous I-beam deck by providing rocker or roller bearings immediately under the stringers. The slender steel rocker-bents were preferred, however, because of their more graceful architectural appearance. The estimated cost of the rigid-frame type of bent was about 50 per cent greater than that of a simple steel bent with sway bracing.

The top of the cross frame of the bents was made level to accommodate rocker bearings for the stringers. These rocker bearings consist of an inverted section of 15-in. channel bolted to the lower flange of the I-beams and set on a rolled steel rocker plate riveted to the bent, the whole forming a key to hold the bents in position relative to the stringers. At the expansion end of the structure the rocker bearings are set on bronze sliding plates.

In this type of construction the most advantageous location for the roadway expansion joint is at one end rather than over an intermediate bent. Since the structure is on a grade of 2.7 per cent, the expansion joint was located at the upper end requiring the deck to push upward under expansion and settle downgrade under contraction. Such an arrangement relieves rather than aggravates the tension stresses set up under contraction.

Due to difficulties previously encountered with different "lap" types of steel roadway expansion dams, the type selected for use on the major steel structures on the Blue Ridge Parkway and inaugurated on this bridge is a cast steel dam composed of two opposite sections with intermeshing teeth, resembling "tooth gear" construction. One section is rigidly bolted to the steel I-beams of the deck and the opposite section is attached to the abutment bridge seat with anchor bolts. In order to prevent the drainage water which seeps through the teeth from coming in contact with the underlying structural steel, a copper-lined trough extends transversely across the roadway under the expansion opening and has sufficient width to catch all water when the dam is fully opened. The gutter is supported by brackets attached to the abutment and is

sloped to drain into an 8-in. cast iron pipe discharging at the ground line of the abutment. The gutter is designed to be removed for cleaning by sliding out endwise.

The expansion dam provides a total opening of 3½ in. or slightly greater than the specification requirement of 1¼ in. for each 100 ft. of structure. Although the cost of the dam was about $2,000, this is not regarded as excessive considering that only one dam is required. A similar type of expansion dam will be used on a 464-ft. continuous girder rocker-bent viaduct now under construction in the Vicksburg National Military Park in Mississippi.

The downgrade or fixed end of the Big Pine Creek bridge is anchored to the abutment against longitudinal movement. Each I-beam stringer rests on a rocker bearing on the abutment bridge seat and is connected to a horizontal steel anchor imbedded in the backwall of the abutment by a pin extending through the lower part of the beam web. The anchors are designed to take both tension and compression. At the expansion end the five stringers head into a cross beam that rests on two combined rocker-and-sliding bearings.

For simplicity in erection, the stringers were spliced over the center of the bents, the splices being designed to take full negative moment developed by the five spans acting in continuity, with additional strength for pull due to drop in temperature.

### Foundations

The abutments and wing walls are of concrete faced with selected local stone, and are founded on compact sand and clay. The wing walls extend parallel with the center line of roadway but flare outward at the ends to meet the shoulders of the roadway which are 30 ft. apart except over the long structures. The wing walls carry stone masonry parapets matching the height of the bridge railing. The exposed face of the stone masonry has a rock face finish with projections beyond the pitch line limited to one inch. The piers are reinforced concrete, with exposed surfaces given a rubbed finish. Of the four piers, two are founded on rock and two are on hardpan.

The construction of the highway as well as the structural design was under the supervision of the U. S. Bureau of Public Roads, of which Thomas H. MacDonald is chief. The preliminary surveys were also made by the Bureau which maintains field headquarters for the Blue Ridge Parkway at Roanoke, Virginia in charge of Wm. M. Austin, senior highway engineer. E. W. Armstrong, assistant highway bridge engineer, has immediate direction of bridge construction. The engineering plans were prepared in the district office of the Eastern National Parks and Forests, Bureau of Public Roads, located in Washington, D. C., of which H. J. Spelman is district engineer. The architectural and landscape features were supplied by the office of the eastern division, branch of plans and designs, of the National Park Service, located in Washington, D. C., of which Arno B. Cammerer is the director and Thomas C. Vint, chief architect.

J. M. Francesa & Company, Fayetteville, West Virginia, was general contractor. The structural steel was subcontracted by the Virginia Bridge Co. Work was started November 2, 1936, and completed May 28, 1937, consuming a total of 208 calendar days. The total cost of the work, inclusive of engineering, was $45,386.32, or $6.10 per sq. ft. of roadway included between curbs and end to end of wing walls.

### Quantities and equipment

The work involved the following items: unclassified excavation for structures, 1,132.7 cu. yd.; Class D concrete for substructures, 577.87 cu. yd.; Class D concrete for deck, 187.27 cu. yd.; Class D concrete for railing, 6.00 cu. yd.; reinforcing steel, 76,253 lb.; cement stone masonry 58.96 cu. yd.; stone masonry in parapets, 35.25 cu. yd.; stone or gravel sheathing, 36.8 cu. yd.; copper lining for gutter, 140 lb.; 8 in. cast iron pipe, 31.5 lin. ft.; structural steel, 262,700 lb.; dampproofing, 105.5 sq. yd. The contract did not include the bituminous paving.

The general contractor's equipment consisted of a two-bag concrete mixer, one 2-ton truck, one ½-ton pick-up, one small stiff-leg derrick, and necessary wheelbarrows, concrete buggies, picks and shovels.

The sub-contractor's equipment consisted of one hoisting engine, one air compressor, two pneumatic riveting hammers, and other necessary field assembling and riveting equipment.

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## Apprentice Opportunities Urged in Public Service Administration

LOCAL GOVERNMENT is fighting a losing battle with private industry for talented managers of the public business unless apprenticeship opportunities are made available to young college graduates, according to a report issued recently by the committee on career service of the International City Managers' Association.

While over 80 colleges and universities offer courses preparing for the public service, scarcely more than a dozen cities a year give graduates a chance at the bottom rung of the career ladder. This year New York City is considering a plan to take on apprentice engineers for a year's intensive practice in city work. Saginaw, Mich. and Austin, Tex. have added graduates in public administration to their city hall staffs for the same purpose. Solution of this paradox, according to the report, lies in part with the administrators already on the job, who must have " a positive attitude of willingness to assume the periodic responsibility of training an apprentice."

A nation-wide local government service that is actually developing "real careers," according to the association's committee, would absorb several hundred apprentices a year. These apprentices would be on strict probation and would not receive permanent appointments until they had proved their ability. The proving process in some cases might extend over several years. In cases of prejudice against taking on non-local residents as apprentices, administrators are urged to discharge their responsibility by making certain that no young persons of exceptional promise in their own community lack opportunity to make a career in local government if they desire it.

# BOOK NOTES AND REVIEWS

*The month's additions to the engineer's reading and reference list*

## Reading for Engineers

**SELECTED BIBLIOGRAPHY of Engineering Subjects—Section 1: Mathematics, mechanics, physics. Section 2: Aeronautical engineering, civil engineering. Section 3: Chemistry, chemical engineering, industrial engineering. Section 4: Electrical engineering, mechanical engineering. Section 5: Metallurgy, minerology and geology, mining engineering. Published by the Engineers Council for Professional Development, 29 W. 39th St., New York City. Price 10c per copy or 5c in quantities of 50 or more.**

This listing of a few of the better books from the many that are available in all branches of engineering is one of the major accomplishments of the Engineers Council for Professional Development. The preparation of such a list was among the first objectives laid down for the Council as it was realized that young men graduating from school who wish to continue their education by appropriate reading and study lack a guide as to which of the many available books should be acquired. These bibliographies, in addition to giving the names of authors and publishers, gives a brief characterization of each book to indicate the nature of the treatment, whether elementary or advanced, and the depth of the subject matter. Of added value is the date of publication of each book.

## House Building Guide

**THE HOUSE OF HEALTH—THE PRACTICAL BOOK OF BUILDING FOR COMFORT AND ECONOMY—By Odd Albert. 127 pp. Published by the Garden City Publishing Company, Inc., Garden City, N. Y. Price $1.00.**

Appealing to the prospective homeowner, the author brings together a mass of miscellaneous information on framing, wall construction, weatherproofing, roofing, heating, and other items of house construction and equipment. Much of the information is presented by individual manufacturers of materials or equipment described and partakes of advertising booklet character. Those who plan to build will find a book to provide them with much useful information.

## Water Treatment

**WATER TREATMENT AND PURIFICATION—By William J. Ryan. 242 pp. Published by McGraw-Hill Book Co., Inc., New York. Price $2.50.**

Summarizing a considerable amount of data in small space, this book furnishes a brief but relatively complete treatise on construction and operation of filtering, softening and other treatment processes applied to water. In addition, explanatory data on the chemical reactions involved in purification practice are also included. Particular attention is given to the subject of boiler feed water, and the special considerations that affect the selection of a treatment process. A bibliography at the end of each chapter is an informative guide for more detailed study.

## Analysis of Dams

**DAS TALSPERRENGENWOLBE — By Karl Hofacker. 125 pp. Published by Leeman & Co., Zurich and Leipzig. Price $7.50 Swiss Fr.**

The analysis of arch dams by means of cantilever and arch elements, originated by H. Ritter in 1913 and later introduced in this country by Fred A. Noetzli (*Transactions*, Am. Soc. C.E., 1921), has been brought to a high degree of perfection by Professor H. M. Westergaard and others in the U. S. Bureau of Reclamation.

The author of the present thesis, adhering to this method in a general way, objects to the Bernoulli-Eulerian assumption of the elementary theory, as inaccurate for thick arches. For this reason he proposes a new method, based on the mathematical theory of elasticity of two dimensions. In addition, he develops approximate methods, which shorten the work without being too inaccurate. A comparison between the exact and the elementary theory revealed that the stresses, computed by the ordinary theory are up to 30 per cent smaller at the downstream face of the arch.

The author tested his theory by means of a model and found that the theoretical and experimental values differ only by 2 per cent.

In spite of the high level of this investigation, its mathematical deductions can be followed easily by engineers of good college training. The numerous tables and diagrams incorporated in the text facilitate the application of the theory to practical problems. The reviewer feels that the book will be read with great pleasure and profit by those interested in the progress of arch dam design.—*Reviewed by* A. FLORIS, *Los Angeles.*

## New Concrete Text

**PRINCIPLES OF PLAIN AND REINFORCED CONCRETE CONSTRUCTION—By E. Probst. Published by Edward Arnold & Co., London, and Longman-Green and Co., New York. Price $10.00.**

In view of the extensive and constantly expanding volume of concrete literature the publication of a general treatise on the subject of plain and reinforced concrete is a courageous undertaking. This is particularly true in connection with the fundamental principles, which have been well stabilized by analysis and research. The author, who undertakes to interpret the value to practice of the great volume of information accumulated by reasearch is particularly well qualified because he speaks from first-hand knowledge of a wide range of investigations carried out in his own laboratory.

Dr. Probst concerns himself especially with the properties of the material itself rather than with structural analysis. He very properly points out that the problems presented by the material cannot be divorced from the purpose for which the structure is to be used. The general technical reader will find in Part I a condensed summary of the data scattered throughout the literature relating to the materials entering into the composition of concrete.

Of particular interest is the discussion of volume changes, in view of the emphasis that is now given to this subject in the design of concrete. The author accepts and emphasizes the importance of the water-cement ratio principle as governing the strength, durability and permeability of concrete, but points out its limitations.

At present, when so much attention is given to the problem of pre-

venting or minimizing cracks in concrete, the revival by the author of the old theory that reinforcement may actually increase the extensibility of concrete is not only interesting but merits the attention of practicing engineers. Also, since the distribution of stresses in beams takes on new importance in application to elastic frames, the author's discussion of beam stress distribution is pertinent.

The section on columns, while it contains valuable historical and test data, leaves in debatable territory the much discussed question of the value of the spiral in columns with protective shells. The author recommends the core area of spiral columns as a basis for estimating bond capacity, with separate allowance for the shell in any given case.

In general, the volume is one for the student of the subject, who will find valuable information to aid him in problems outside of his own immediate experience. It is not a handbook but rather a compilation and selections of data and principles.—Reviewed by A. E. LINDAU, *Chairman, Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.*

## *MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS*

CURRENT HYDRAULIC LABORATORY RESEARCH is summarized in a semi-annual report of current hydraulic research in 50 U. S. laboratories published as Bulletin V-2 of the National Bureau of Standards, Washington, D. C. Included is data on hydraulic research in France and Canada.

SOIL STUDIES by Juul Hrorslev have been published (in Danish) by Danmarks Naturviden skabelige Samfund, Vimmelskaftet 32, Kobenhavn, Denmark. The paper relates to the physical properties of remolded cohesive soil and contains an abstract in English. Price, 6 kr.

GERMICIDAL EFFICIENCIES of different chlorine compounds are reported by David Charlton and Max Levine in Bulletin No. 132 of the Iowa Engineering Experiment Station. Copies may be obtained free of charge upon request to the Director of the station at Ames, Iowa.

ROADBED STABILIZATION BY DRAINAGE is the subject of a pamphlet distributed by the Armco Culvert Manufacturers Association, Middletown, Ohio.

THE NEW BUILDING CODE of New York City was published as the July 9 issue of *The City Record*. Copies may be obtained from *The City Record*, 2213 Municipal Building, New York City. Price 10 cents.

SNOW-SURVEY PAPERS presented at the South Continental Divide Snow-Survey Conference of last June are published in the current *Transactions* of the American Geophysical Union, National Academy of Sciences, Washington, D. C.

SMOKE REGULATIONS governing details of fuel-burning equipment required for issuance of permits and certificates have been published by the Hudson County (N. J.) Board of Health. Copies can be had at six cents each by addressing William G. Christy, Court House, Jersey City, N. J.

SOIL STABILIZATION is the subject of three papers contained in Bulletin No. 47, American Road Builders Association, Washington, D. C. The papers are: "Role of Soil Binders and Aggregates in Soil Stabilization", "Road Stabilization", and "Stabilization with Aggregate, Binder-Soil and Calcium Chloride."

### *Other Pamphlets*

GUIDE TO TRAFFIC SAFETY: Published by the Bureau of Public Roads and obtainable from the Superintendent of Documents, Washington, D. C. for 10c.*** REPORT ON TESTS TO DETERMINE THE FIRE RETARDANT AND LEACHING PROPERTIES OF WOOD PRESERVATIVE SALT TREATMENT: published by E. I. DuPont de Nemours & Co., Wilmington, Del.*** PROGRESS REPORT, 1937; statement of the Advisory Committee to the National Resources Committee. Superintendent of Documents, Washington, D. C., price, 10c.*** HIGHWAY USER TAXES, National Highway Users Conference, National Press Building, Washington, D. C.*** PAPERS presented at the 24th Annual Conference on Highway Engineering, University of Illinois, Circular 30, Engineering Experimental Station, Urbana, Illinois. Price 50 cents.

## *NEW PUBLICATIONS*

CONCRETE DESIGN MADE EASY—By V. A. Dighe. 108 pp. Published by The Associated Cement Companies, Ltd., Esplanade House, Waudby Road, Bombay, India. Price Rs.3/, plus postage.

REGIONAL PLANNING: PART V—RED RIVER OF THE NORTH—August 1937. Prepared by the National Resources Committee. 80 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 25c (paper cover).

PAPERS ON THE SCIENCE OF ADMINISTRATION—Edited by Luther Gulick and L. Urwick. 195 pp. Published by the Institute of Public Administration, Columbia University, New York. Price $3.

PORTRAITS OF THE IRON HORSE—By Robert S. Henry and Otto Kuhler. 80 pp. Published by Rand McNally & Co., Chicago. Price $2.

STREET TRAFFIC-CITY OF DETROIT-1936-1937—313 pp. Prepared and published by the Michigan State Highway Department, Lansing, Mich.

LABOR'S ROAD TO PLENTY—By Allen W. Rucker. 221 pp. Published by L. C. Page & Co., Boston. Price $2.50.

RESULTS OF MUNICIPAL LIGHTING PLANTS—Fifth Edition. 230 pp. Published by The Burns & McDonnell Engineering Co., Kansas City, Mo. Price $2.

BUSINESS ADMINISTRATION FOR ENGINEERS—By C. Francis Harding and Donald T. Canfield. 637 pp. Published by McGraw-Hill Book Co., New York and London. Price $5.

FLOODS OF MARCH 1936—Part I, New England Rivers—Geological Survey Water-Supply Paper 798. 466 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 70c.

HYDRAULIC STRUCTURES—By A. Schoklitsch. Vols. I and II: An English translation of Der Wasserbau. 1172 pp. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York. Price $18.

GROUND WATER—By C. F. Tolman. 593 pp. Published by McGraw-Hill Book Co., New York & London. Price $6.

MIGHTY ENGINEERING FEATS—By Harriet Salt. 308 pp. Published by The Penn Publishing Co., Philadelphia. Price $2.50.

GLOSSARY OF PHYSICS—Compiled and edited by LeRoy D. Weld. 255 pp. Published by McGraw-Hill Book Co., New York and London. Price $2.50.

# THE WEEK'S EVENTS

(Continued from page 847)

## Rust on Reinforcing Bars Studied

A series of tests of the effect of rust on the bond between reinforcing bars and concrete is to be undertaken by the Concrete Reinforcing Steel Institute in cooperation with Lehigh University. The test is to be divided into two parts, consisting of a comparatively thorough program which will require from 15 to 18 months to complete, and a smaller program which will yield usable results very quickly.

This preliminary program will involve embedding 5/8-in. round deformed bars, taken directly from warehouse stock and of varying degrees of rustiness, in concrete cylinders, leaving one end exposed. The cylinders will then be placed in testing machines and the force required to produce initial slip of the bar in the concrete will be measured.

In order to make the test data more valuable to inspectors in the field, careful photographs will be taken of the surface condition of the bars used in the test and published with the test data. It will then be possible for an inspector to compare the bars he is examining with the photographs and predict very closely what the behavior of the bars will be in the concrete.

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## Parking Meters Rejected At Sacramento

Sacramento, Calif. voters, at an election Nov. 2, voted down a proposal to give parking meters a trial in the business district of the city. The ordinance, defeated by a vote of 15,000 to 4,000, would have permitted the city to place 5-cent parking meters on streets in the business section for a trial period of 90 days.

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## State Housing Aid Urged At New York Meeting

Loans by New York State to local housing authorities and city bond issues for housing outside of municipal debt limit restrictions should be provided for by the forthcoming New York state constitutional convention, it was recommended Nov. 13 by the New York State Institute on the Application of the United States Housing Act. This was a gathering of organizations interested in public housing, held under the sponsorship of the National Public Housing Conference.

Resolutions adopted by the institute included a call for state loans at low interest rates and grants to match local funds for local housing agencies; state loans to cooperative and limited dividend corporations; authorization for municipalities to aid low-rent housing projects and to exempt indebtedness incurred for such purposes from constitutional debt limits. Broader use of condemnation powers to aid in slum clearance and acquisition of reserve land by cities in advance of the needed use for housing, recreational, and educational purposes was also urged.

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## New York Snow Fighters Train at Lake Placid

Two hundred men from the snow-fighting force of the New York City department of sanitation are to be given preliminary training in the handling of the city's new mechanical snow removing equipment at Lake Placid, N. Y., where snow usually falls before it does in the city. Equipment on which the men will be trained has already been shipped to Lake Placid, and training will begin as soon as snow falls there. Instructions will be given by representatives of the manufacturers of the equipment.

The men will be sent in groups of 30 and will be given three days of training in the operation of this equipment. Arrangements have been made to make use of the airport at Lake Placid, which will provide ample room to push snow around until the men know their jobs.

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## Chicago River Locks To Be Lighted

The new locks at the source of the Chicago River will be illuminated by means of 20 sodium vapor lights, the Chicago sanitary district has decided. The locks, now nearing completion, will control the flow of water from Lake Michigan to conform with the diversion limit set by the courts.

The decision to use sodium vapor lighting equipment was taken as the result of successful use of these lamps on a number of experimental installations on streets in the Chicago area.

## Explosive Gases Found In City Water Supply

Accumulations of the explosive gas, methane, in the underground municipal water supply of Clinton, Ill., have been disclosed by an investigation undertaken after an explosion which occurred Aug. 12 in the settling basin of the Clinton city waterworks. The explosion, which caused considerable property damage but no personal injuries, was investigated by the federal Bureau of Mines.

The investigation disclosed that water produced from deep wells operated by the city water department contained methane, which was released into the atmosphere when pressure was released. The same gas was also found in the water supply of the public schools in the nearby town of Wapella; a janitor was severely burned some months ago by an accumulation of this gas in the basement of the Wapella high school.

As a means of reducing the hazard arising from the presence of the gas, the Bureau of Mines suggested complete aeration of the water to remove the methane and the use of "permissible" enclosed motors on pumps. Efficient ventilation of enclosed settling tanks is urged as well as the prohibition of smoking in pump rooms or near settling tanks. Where wells are used to supply water to schools or dwellings, it is recommended that the wells be situated at least 200 ft. from the building and the water be completely aerated at or near the pump house before it enters the pressure tank.

Examination of drill hole records of oil wells in the area disclosed that the presence of methane in the underground water is due to decomposition of glacial peat beds. Methane, ammonia gas, and traces of hydrogen sulphide, arising from the decomposition of vegetation, are sealed with carbon dioxide under pressure in contact with the water in the adjacent sand and gravel bed. The water takes into solution quantities of these gases, which are subsequently released and the pressure on the water is relieved.

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## Taylor Dam Completed

Taylor Dam was completed early this month at a cost of about $1,174,000. The 168-ft. earth-fill structure near Almont, Colo., will store 106,239 acre-ft. of the waters of the Taylor River, a tributary of the Gunnison River. It is a part of the Uncompahgre reclamation project.

The contract for construction of the dam was awarded by the Bureau of Reclamation in February, 1935, to the Utah-Bechtel-Morrison-Kaiser Co.

## CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN STANDARDS ASSOCIATION, annual meeting, Astor Hotel, New York City, Dec. 1.

HIGHWAY RESEARCH BOARD, annual meeting, Washington, D. C., Dec. 1-3.

THE ASPHALT INSTITUTE, national asphalt conference, Memphis, Dec. 6-13.

ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, annual meeting, Memphis, Dec. 6-11.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Netherlands Plaza Hotel, Cincinnati, Jan. 12-14.

AMERICAN ENGINEERING COUNCIL, annual convention, Washington, D. C., Mayflower Hotel, Jan. 13-15.

SECRETARIES OF ENGINEERING ORGANIZATIONS, annual conference, Washington, D. C., Mayflower Hotel, Jan. 13-15.

AMERICAN ROAD BUILDERS ASSOCIATION, road show and convention, Cleveland, Jan. 17-21.

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, Chicago, Congress Hotel, Jan. 18-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York City, Jan. 19-21.

ENGINEERING INSTITUTE OF CANADA, annual meeting, London, Ont., Jan. 31-Feb. 1.

REGIONAL AND LOCAL

INDIANA SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Indianapolis, Ind., Dec. 10.

LOUISIANA ENGINEERING SOCIETY, annual meeting, St. Charles Hotel, New Orleans, Jan. 7-8.

NEW JERSEY ASSOCIATION OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS, Elks Club, Jersey City, N. J., Jan. 14-15.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual meeting, New York City, Jan. 20-22.

NORTH CAROLINA SOCIETY OF ENGINEERS, Raleigh, annual meeting, Raleigh, Jan. 28-29.

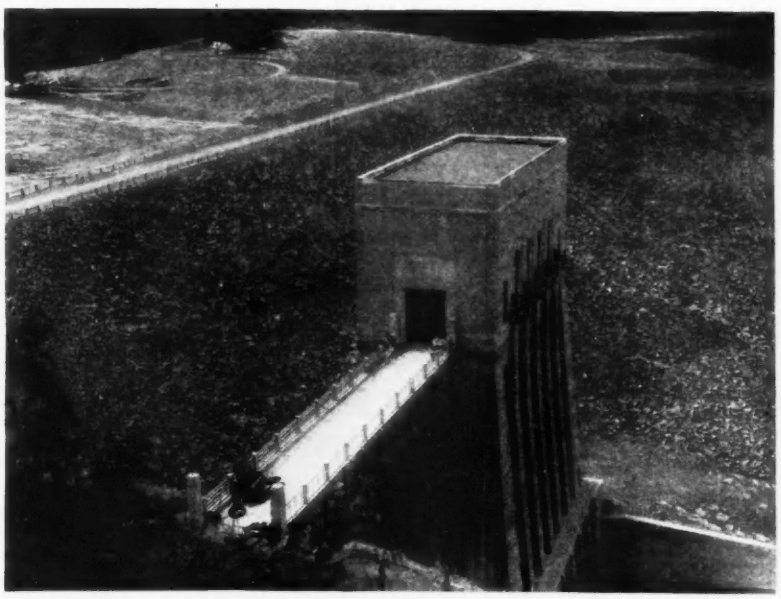
ELECTIONS AND ACTIVITIES

THE SOUTHWEST SECTION of the American Water Works Association at its Galveston meeting Oct. 18-21 elected the following officers for the coming year: Thomas Amiss, chairman; Albert Davis, vice-chairman; L. A. Quigley, Forth Worth, secretary-treasurer; state trustees, Louisiana, A. F. Theard; Arkansas, L. A. Jackson; Oklahoma, M. T. Vanlandingham; Texas, Robert Harding.

THE ENGINEERS SOCIETY of Milwaukee Oct. 20 elected James Ferebee president for the coming year. Other officers are G. G. Post, vice-president and Walter R. Mueller, secretary-treasurer. Life memberships in the American Society of Civil Engineers were conferred on Alfred C. Bell, Louis E. Bagen, Daniel W. Mead, Clinton B. Stewart and F. E. Turneaure.

FRANK CLOUGH, city engineer of South Pasadena, Calif., has been elected president of the Pacific Coast Building Officials Conference. D. K. Rossele, Oakland, was elected first vice-president, and L. A. Ferris, Reno, Nev., second vice-president.

RHEA REES, of Sioux Falls, was elected president of the South Dakota Water and Sewage Works Conference at a recent meeting. Charles R. Price, of Rapid City, was elected vice-president, and W. W. Towne, state sanitary engineer, was re-elected secretary and treasurer.



MUSKINGUM PROJECT NEARS COMPLETION

ALL CONSTRUCTION in the $44,000,000 Muskingum flood control project will be completed by January 1, army engineers expect. Clendening Dam on Brushy Fork Creek and Bolivar Dam on Sandy Creek are the eleventh and twelfth of the fourteen dams to be completed.

Mohawk Dam, shown above, is the key reservoir of the Walhonding system of the Muskingum project. This system includes the Pleasant Hill, Charles Mill and Mohicanville Dams. Mohawk Dam, on the Walhonding River five miles west of Warsaw, Ohio, is a rolled earth, gravel, and rock-fill structure 111 ft. high and 2,330 ft. long. Outlets through twin tunnels are controlled by six 8 x 17 ft. caterpillar type gates.

Construction of the dam involved abandonment of the Walhonding branch of the Pennsylvania R.R. and construction of a steel bridge and a concrete pile trestle for the railroad, as well as relocation of 1.8 mi. of line. Fifteen mi. of state highway and 1.7 mi. of secondary road also had to be relocated.

Total cost of construction and relocation work on the reservoir is $3,604,000.

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## License Examinations

Iowa: Examinations for professional engineering Dec. 7-8 and for land surveying Dec. 9 at Des Moines.

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## Indiana Cities Agree To Treat Sewage

The city of Gary, Ind., has decided to comply with a state order to stop its pollution of Lake Michigan, and officials of Hammond, Ind., which has received a similar order are meeting with the Indiana board of health to consider ways and means of financing and building sewage disposal facilities.

Gary has already decided to create a sanitary district, and Hammond will choose between that method and a plan to use funds obtained from the sale of city bonds.

## PERSONAL

JAMES A. ANDERSON, formerly head of the department of civil engineering at Virginia Military Institute, has been made dean of the faculty. The nomination is subject to confirmation by the board of visitors.

L. A. WOODWARD, formerly division engineer for PWA, has been appointed county engineer of Lancaster County, Nebr., with headquarters at Lincoln.

C. F. DEARMOND has been appointed engineer for the Nevada Colorado River Commission. He will open offices in Las Vegas.

WILLIAM C. MERRYMAN has resigned as resident engineer on subway construction for the Interborough Rapid Transit Co. of New York City after 37 years in that position. Mr. Merryman graduated from Bowdoin College in 1878, later receiving graduate degrees from that institution and studying for a time at Massachusetts Institute of Technology. After several years service on the construction of the St. Paul water works, Mr. Merryman became assistant engineer of St. Paul, holding the position for five years until, in 1890, he began private practice in that city. Then, after brief connection with a number of railroads and contracting firms, mostly in bridge and tunnel work, Mr. Merryman took, in October, 1900, the position with the Interborough which he held until his recent retirement.

W. R. HOLWAY and H. C. NEUFFER have formed a partnership for the practice of engineering with offices in Tulsa, Okla., and Albuquerque, N. Mex. They have been engaged as engineers of the Grand River hydro-electric project near Pensacola, Okla. Mr. Holway has been in consulting practice for 20 years in the Southwest and in several foreign countries, including Cuba and Russia. Mr. Neuffer has been connected with the Indian service and private irrigation projects in the Southwest for many years. He was designing engineer for the Coolidge Dam and was for six years supervising engineer for the Indian service at Albuquerque.

F. H. SCHRADER was recently appointed state highway engineer of South Dakota. Previous to his appointment, he was construction engineer in the highway department.

HANS R. F. HELLAND has been appointed general manager of Willacy County irrigation district No. 1, succeeding Julian Montgomery, who recently resigned to become Texas State Highway Engineer. Mr. Helland, a graduate in 1911 of the University of Texas, has done railway work in this country and Germany and for the past eighteen years has practiced actively in Texas, engaging in highway, building, and municipal work, partly in private practice and partly as city engineer of various Texas communities.

OTTO JABELMANN has been appointed assistant to the president of the Union Pacific R.R. in charge of research. Mr. Jabelmann has been in charge of the research department since its consolidation a year ago with the title of assistant superintendent of motive power and machinery.

WALTER THOMAS has been appointed project engineer of the Philadelphia Housing Authority. Mr. Thomas is an architect who has practiced in Philadelphia and he is secretary of the City Planning Commission there.

J. G. CARON has been appointed technical assistant to the director of the Montreal Department of Public Works.

D. B. LAMARCHE has been appointed chief engineer of the Montreal Sewers Commission.

W. J. GALLAGHER has been appointed city engineer of Rock Island, Ill. Mr. Gallagher has recently been in charge of the preliminary survey of the Davenport water works project for the Federal Engineering Co. and was for several years before that an instructor at St. Ambrose College. He is a graduate of Saint Ambrose College and the State University of Iowa.

HENRY C. ANDERSON, professor of mechanical engineering at the University of Michigan and a member of the faculty there since 1900, has been appointed dean of the college of engineering, succeeding Prof. Herbert C. Sadler.

REAR ADM. R. E. BAKENHUS, Civil Engineer Corps, U. S. Navy, retired, has opened offices in New York City for the practice of consulting engineering.

CHARLES HAGEMAN has been appointed to direct planning work connected with the development of the waterfront area of The Dalles, Ore. Mr. Hageman was resident engineer on the construction of cargo wharves for the port two years ago.

ANDREW H. PETERSON, who has been state director of PWA for Massachusetts, retired from government service Oct. 31, when the state PWA offices were closed, and has returned to the contracting firm of Starrett Bros. and Eken, with whom he was formerly associated; he will open offices in Boston to represent the company there.

A. G. SABOURIN, who has been public works engineer in the District of Quebec, has been appointed superintending engineer in the Canadian Department of Public Works at Ottawa.

BRUNO GRANDMONT has been appointed public works engineer of the District of Quebec, succeeding A. G. Sabourin.

JOHN P. SPARKS, retired building contractor, has been appointed city engineer of Kirkwood, Mo.

## OBITUARY

E. ARNETT SMITH, 64, an engineer connected with the Panama Canal from 1913 to 1917 and lately district manager of the Richards-Wilcox Mfg. Co., Cleveland, died recently in that city. Mr. Smith was a graduate of Rose Polytechnic Institute.

WILLIAM F. OSBORNE, for 26 years connected with the New York Central R.R. as a civil engineer and bridge designer, died Nov. 11 in New York City at the age of 66. Mr. Osborne was a graduate of New York University.

ROBERT A. BEER, Baltimore civil engineer, died in Baltimore Nov. 6 at the age of 40. Mr. Beer had served with the U. S. Engineers on work in Colorado and New Mexico and had been connected with J. B. Griener Co., Baltimore engineers.

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## *Nine Million Vehicles Cross Bay Bridge*

When the San Francisco-Oakland Bay bridge completed its first year of use Nov. 12, about 9,250,000 vehicles, carrying more than 20,000,000 persons, had crossed the bridge. During the 12-month period, the bridge had earned more than $5,000,000, placing the structure first among the toll bridges of the world in point of earnings. It ranks third in volume of traffic.

Although slightly more than 9,000,000 vehicles crossed the bridge between Nov. 12, 1936 and Nov. 1, 1937, there were only 34 accidents occurring on the bridge proper which inolved personal injury and only four of these were fatal. This gives the bridge an accident frequency of 860,000 car-miles per accident as compared with 262,500 for the United States as a whole during 1936 and 487,500 for California during the same year.